CC Technical Documentation
NPM-10 (3595) Series Transceivers

Troubleshooting - RF

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RF Troubleshooting

Abbreviations in Troubleshooting Charts

Table 1: Troubleshooting Abbreviations

Abbreviation	Definition
BB	Base band
DC	Direct current
ESD	Electrostatic discharge
FEM	Front End Module
LF	Low frequency
LO	Local oscillator
LPF	Low pass filter
PA	Power amplifier
PLL	Phase-locked loop
PWB	Printed wiring board
RCT	Radio communication tester
RF	Radio Frequency
Rx	Receiver
Tx	Transmitter
UHF	Ultra-high frequency
VCO	Voltage-controlled oscillator

Introduction

Two types of measurements are used in this chapter. It will be specified if the measurement type is RF or LF.

- Use a spectrum analyzer with a high impedance probe for RF measurements. Also, it is recommended that you use a good phone as a benchmark for the measurement technique because signal levels can vary depending on the measurement setup. Measurements stated in this section were done with an HP85024 high-impedance probe.

  Note: The test jigs have some losses which must be taken into consideration when calibrating the test system.

- Use a 10:1 probe and an oscilloscope to measure the LF (low frequency) and DC (direct current). The probe used in this chapter is an 10MΩ/8pF passive probe. If using another probe, keep in mind that the voltages displayed may be slightly different.

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Always make sure the measurement set-up is calibrated when measuring RF parameters on the antenna pad. Remember to include the loss in the module test jig when realigning the phone.

Most RF semiconductors are static-discharge sensitive. Use ESD protection during repair (ground straps and ESD soldering irons). Mjoelner is moisture-sensitive, so parts must be pre-baked prior to soldering.

Apart from key components described in this section, there are a lot of discrete components (resistors, inductors, and capacitors) for which troubleshooting is done by checking whether the soldering of the component is done properly, and whether the component is missing from the PWB. Capacitors can be checked for short-circuits and resistors for value by means of an ohmmeter, but be aware that in-circuit measurements should be evaluated carefully.

In this chapter, both GSM and GSM 850 will be used for the lower band and both PCS and GSM 1900 will be used for the upper band.

General Description of the RF Circuits

Figure 1 and Figure 2 include different colors in the block diagrams. The GSM 850 signal route is red, the GSM 1900 route is green, and the common signal lines are blue. Control, supply voltage, and unused lines are shown in black.

Receiver Signal Path

The signal from the antenna pad is routed to the front end module (N700). The GSM 850 signal passes through the switch inside the FEM to TGSM_Rxout, and the GSM 1900 signal passes through the switch inside the FEM to PCS_Rxout.

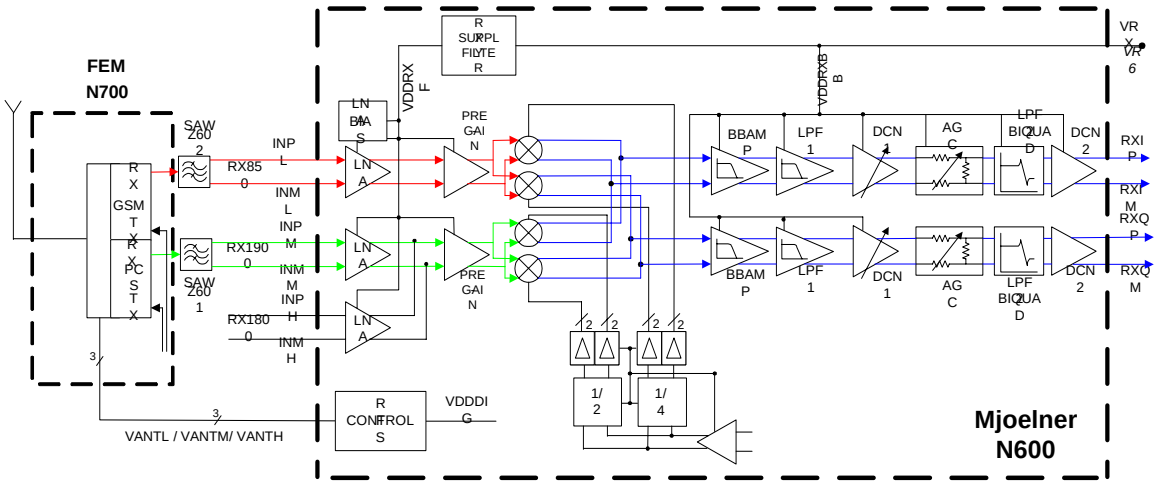

Figure 1: Receiver signal path

From the FEM PA, the GSM 850 signal is routed to the SAW filter (Z602). The purpose of the SAW filter is to provide out-of-band blocking immunity and to provide the LNA in Mjoelner (N600) with a balanced signal. The front end of Mjoelner is divided into an LNA and a pre-gain amplifier before the mixers.

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The output from the mixer is fed to the Mjoelner BB where the signal is amplified in the BBAMP, and the low pass is filtered in LPF1 before the DC compensation circuits in DCN1. The DCN1 output is followed by a controlled attenuator and a second low pass filter (LPF2). The output from LPF2 is DC centered in DCN2 before being fed to the BB for demodulation.

The GSM 1900 signal chain is similar to GSM 850, but the signal is routed through the SAW filter (Z601).

Transmitter Signal Path

The I/Q signal from the BB is routed to the modulators for both 850 MHz and 1900 MHz. The output of the modulators is either terminated in a SAW filter (Z603) for GSM 850 or a balun (T602) for GSM 1900. The amplitude's limited signal is then amplified in the PA of the FEM (N700). The internal FEM detector, some discrete components, and the Mjoelner IC (N600) make up the transmitter gain control circuitry. In order to establish the right Tx output power level, a sample of the signal is taken from the FEM detector and used in the gain control loop. The Tx signal from the FEM is routed to the antenna, which depends on the internal switch setting of the FEM.

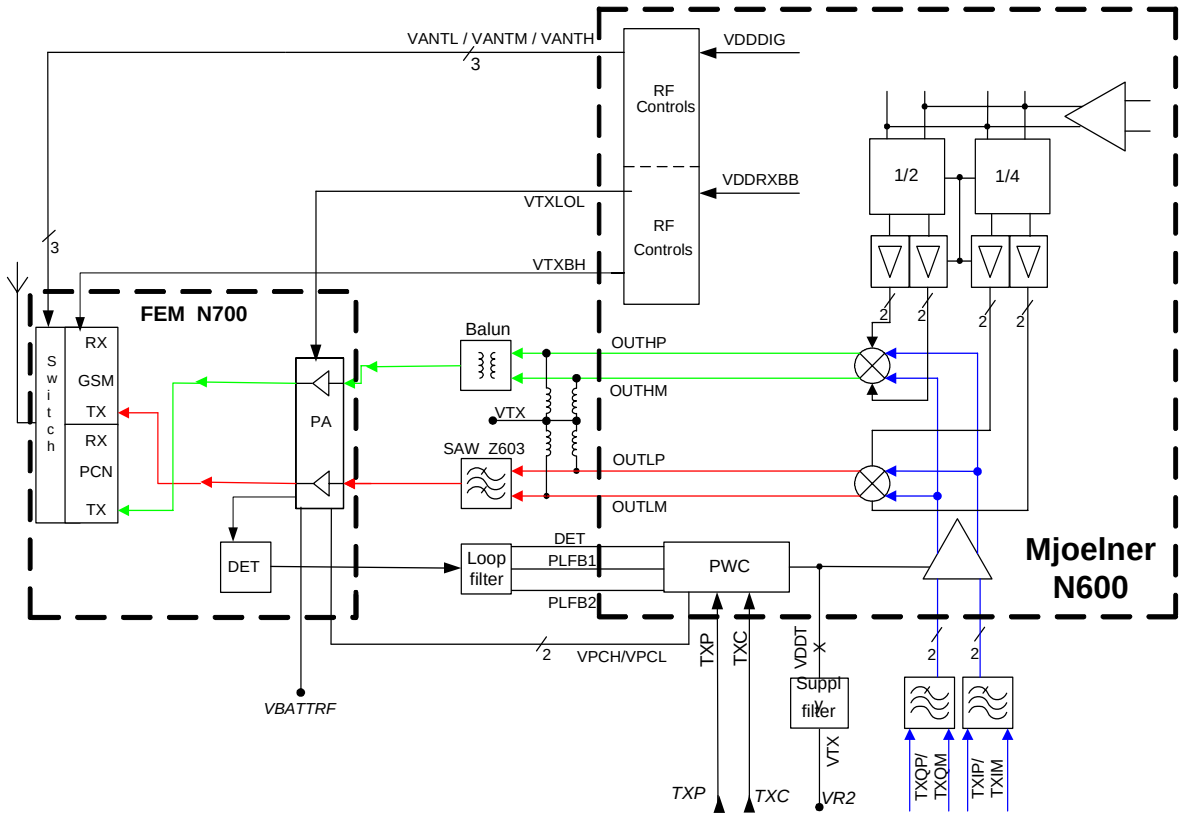

Figure 2: Transmitter signal path

PLL

The phase-locked loop (PLL) supplies local oscillator (LO) signals for the Rx and Tx mixers. In order to generate LO frequencies for the required GSM and PCS channels, a regular synthesizer circuit is used. All PLL blocks (except for the VCO, reference X-tal, and loop filter) are located in the Mjoelner IC.

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The reference frequency is generated by a 26 MHz, voltage-controlled X-tal oscillator (VCXO), which is located in Mjoelner. Only the X-tal is external. Twenty-six MHz is supplied to the BB, where a divide-by-2 circuit (located in the UPP IC) generates the BB clock at 13 MHz. The reference frequency is supplied to the reference divider (RDIV) where the frequency is divided by 65. The output of RDIV (400 kHz) is used as the reference clock for the phase detector (φ).

The PLL is a feedback control system, which controls the phase and frequency of the LO signal. Building blocks for the PLL include:

- Phase detector
- Charge pump
- Voltage-controlled oscillator (VCO)
- N-divider
- Loop filter

Note: As mentioned earlier, only the VCO, reference X-tal, and loop filter are external to the Mjoelner IC.

The VCO (G600) is the component that actually generates the LO frequency. The VCO generates a differential RF output based on the control voltage input. This signal is fed to the prescaler and N-divider in Mjoelner. Together, these two blocks divide the frequency by a ratio based on the selected channel. The divider output is supplied to the phase detector, which compares the frequency and phase to the 400 kHz reference clock. Based on this comparison, the phase detector controls the charge pump to either charge or discharge the capacitors in the loop filter. By charging/discharging the loop filter, the control voltage to the VCO changes and the LO frequency changes. Therefore, the PLL keeps the LO frequency locked to the 26 MHz VCXO frequency.

The loop filter consists of the following components: C639-C641 and R618-R619.

The PLL is operating at twice the channel center frequency when transmitting or receiving in the PCS band. For the GSM band, the PLL is operating at four times the channel frequency. Therefore, divide-by-2 and divide-by-4 circuits are inserted between the PLL output and LO inputs to the PCS and GSM mixers.

Table 2 shows the PLL frequency plan.

Table 2: PLL Frequency Plan

Frequency Band		Channel #	System Frequency Band [MHz]	PLL Frequency Band [MHz]
GSM	Rx Tx	128 - 251	869.2 - 893.8 824.2 - 848.8	3476.8 - 3575.2 3296.8 - 3395.2
PCS	Rx Tx	512 - 810	1930.2 - 1989.8 1850.2 - 1909.8	3860.4 - 3979.6 3700.4 - 3819.6

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As Table 2 indicates, the PLL must be able to cover the frequency range from 3296.8 MHz to 3979.6 MHz.

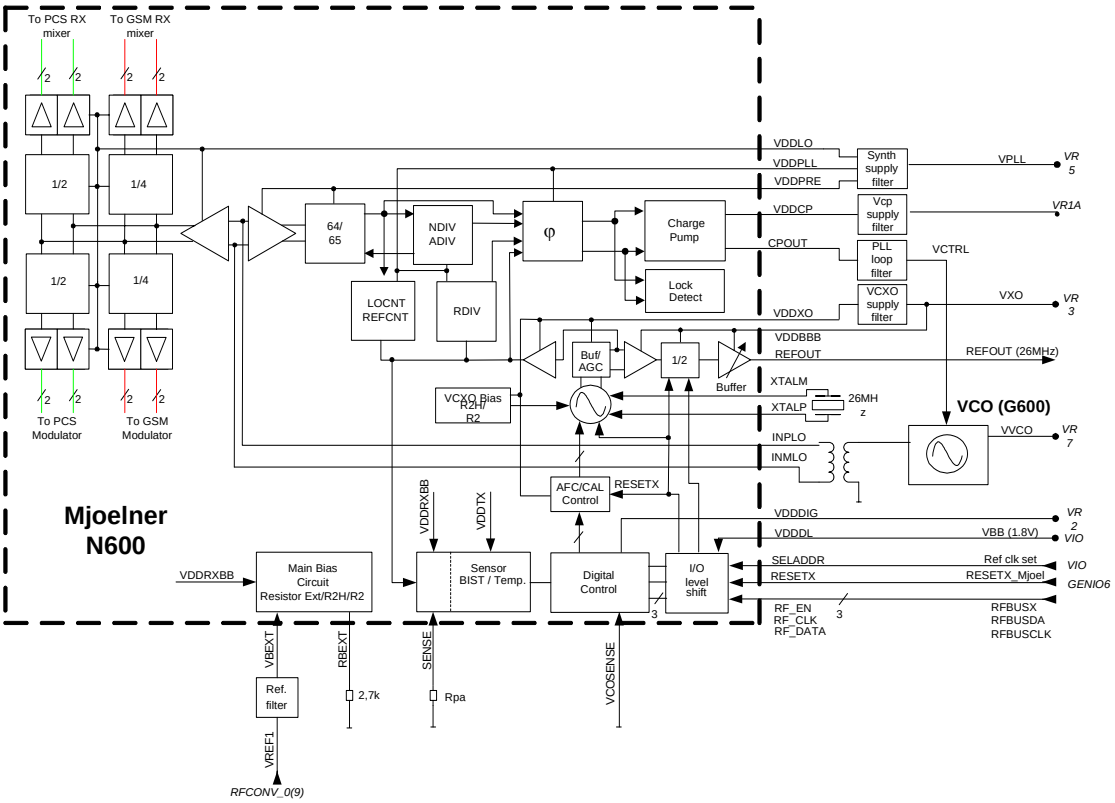

Figure 3: Synthesizer block diagram

Key RF Component Placement

Refer to Table 3 and Figure 4 for key RF component locations.

Table 3: Key RF Components

Component	Description
N600	Mjoelner RF IC
Z601	PCS Rx SAW
Z602	GSM Rx SAW
Z603	GSM Tx SAW
B600	26MHz crystal
G600	VCO (3.6GHz UHF VCO)
N700	Front End Module (FEM)

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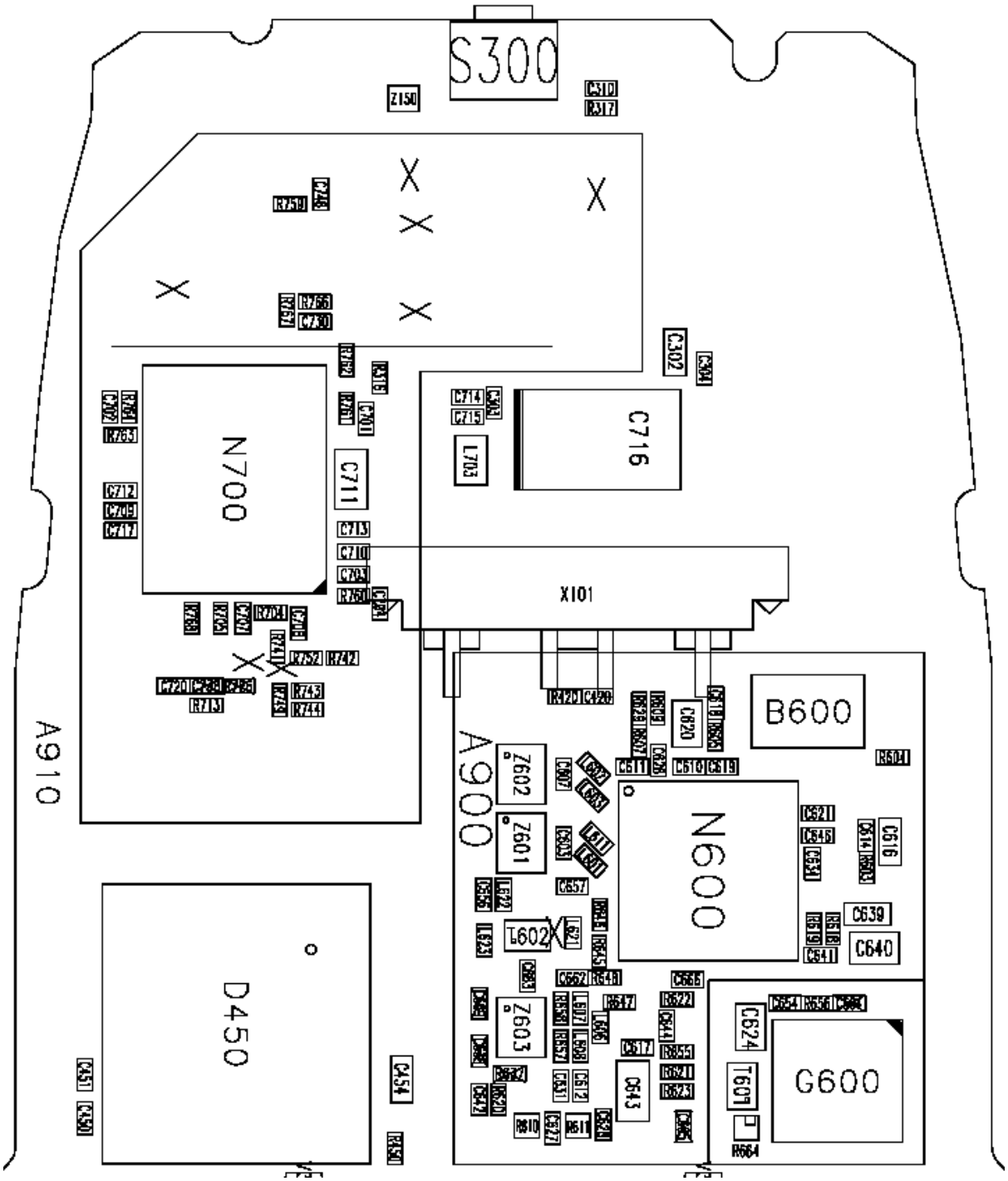

Figure 4: Key RF Component Locations

Power Supply Configuration

All power supplies for the RF unit are generated in the UEM IC (D200). All power outputs from this IC have a decoupling capacitor at which the supply voltage can be checked.

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Figure 5 shows the power supply configuration used in the NPM-10 (3595) phone.

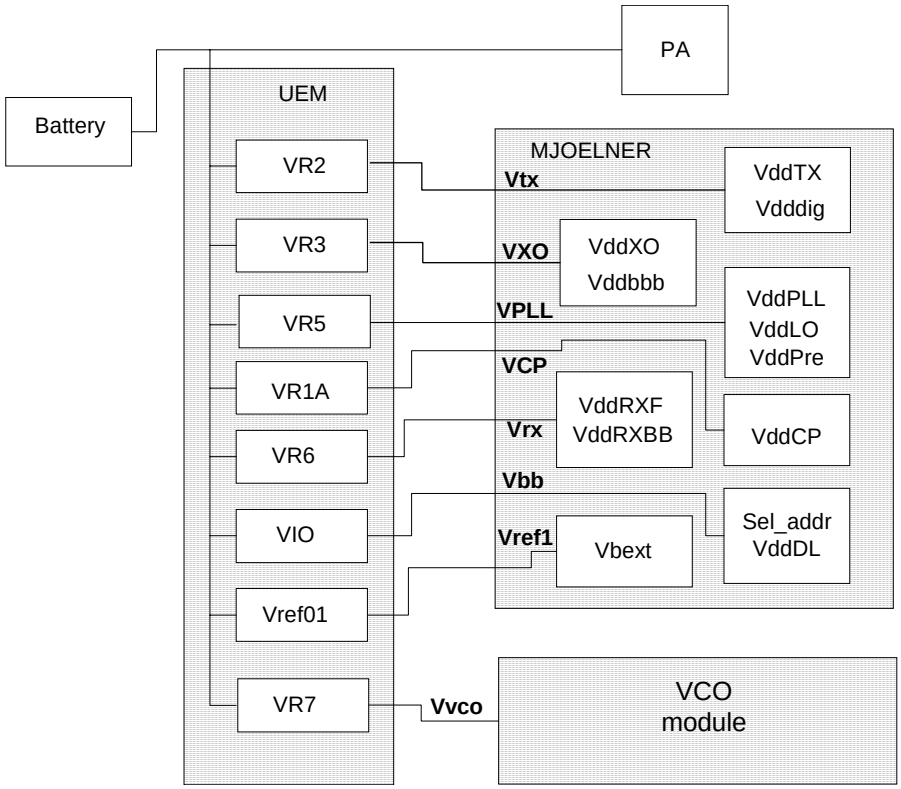

Figure 5: Power supply configuration

The names in **bold** are signal names, which are used in the RF schematics. The names in the boxes within the Mjoelner and VCO refer to pin names on the respective ICs (N600, G600).

Table 4: Power Supply Details

RF Supply Name	UEM Supply Name	Minimum	Type	Maximum	Unit
VTX	VR2	2.64	2.78	2.86	V
VXO	VR3	2.64	2.78	2.86	V
VCP	VR1A		4.75		V
VPLL	VR5	2.64	2.78	2.86	V
VRX	VR6	2.64	2.78	2.86	V
VVCO	VR7	2.64	2.78	2.86	V
VBB	VIO	1.72	1.8	1.88	V
VREF2	VrelRF01	1.334	1.35	1.366	V
VBATT	BATTERY	3.1	3.6	5.2	V

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Figure 6 shows the measuring points at the UEM (D200).

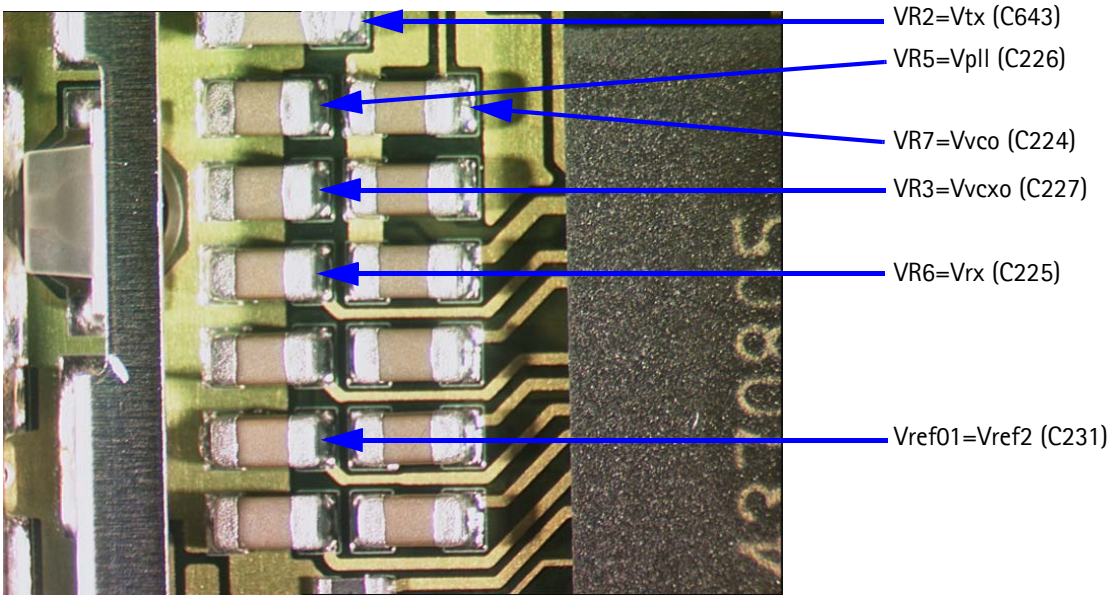

Figure 6: Supply points at the UEM (D200)

Figure 7 shows the supply point at the Mjoelner (N600).

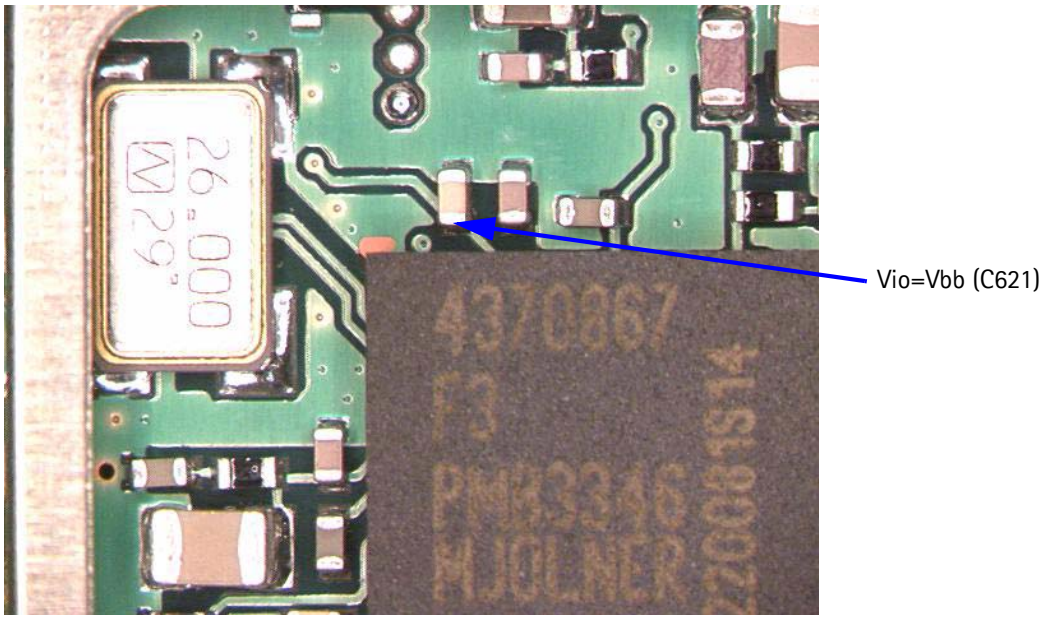

Figure 7: Supply point at the Mjoelner (N600)

Receiver

General Instructions for GSM 850 Rx Troubleshooting

Use the following steps to troubleshoot the GSM 850 Rx:

1. Connect the phone to a PC with the module test jig.
2. Start Phoenix, and establish a connection to the phone.
3. Open the **File** menu, and click **Scan for Product**.

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4. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
5. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 850
   - **Active Unit** = Rx
   - **Operation Mode** = Continuous
   - **Rx/Tx Channel** = 190
   - **AGC** = 9

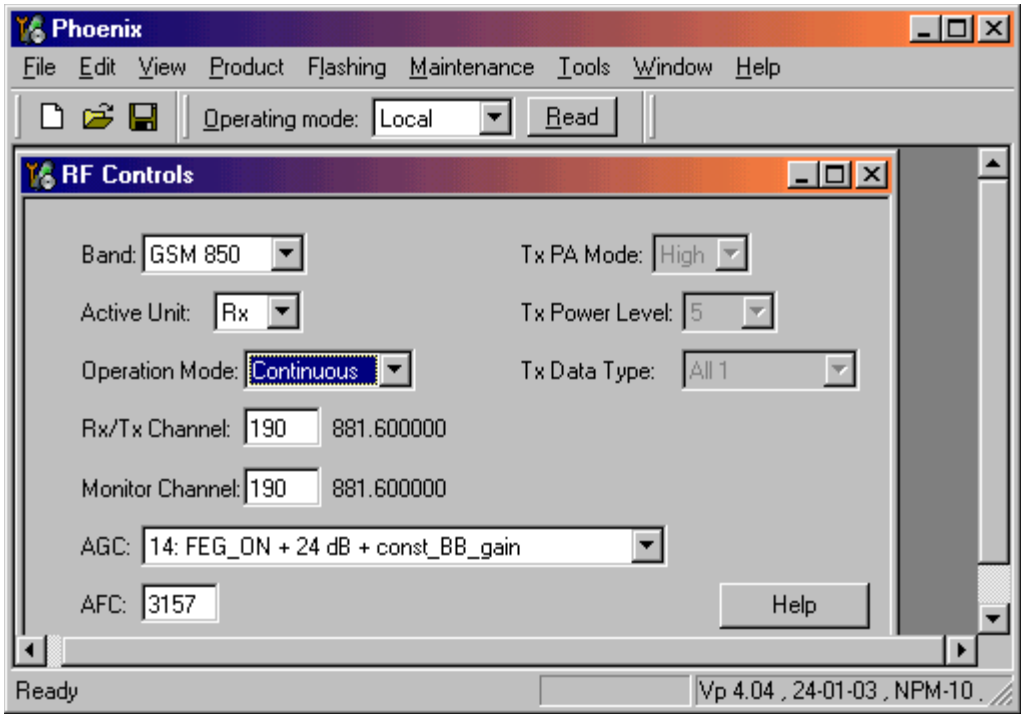

Figure 8: GSM 850 Rx values on the RF Controls dialog box

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Troubleshooting Chart for the GSM 850 Receiver

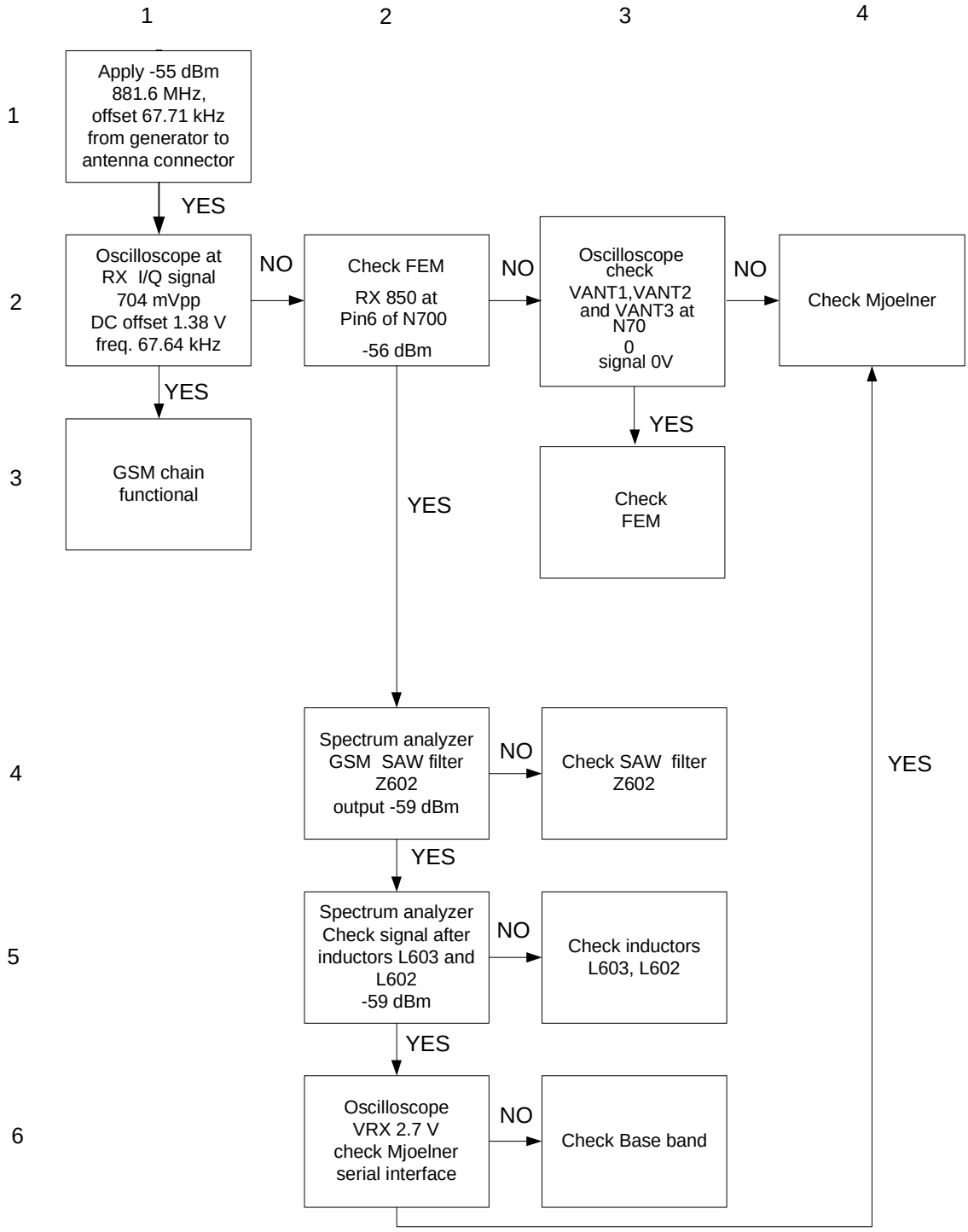

Figure 9: GSM 850 receiver troubleshooting chart

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Figure 10 shows the results of measuring with an oscilloscope at RXIP or RXQP on a working GSM 850 receiver.

- Signal general frequency = 881.66771 MHz
- Amplitude = -55 dBm
- Signal amplitude peak = 704 mV
- DC offset = 1.38 V

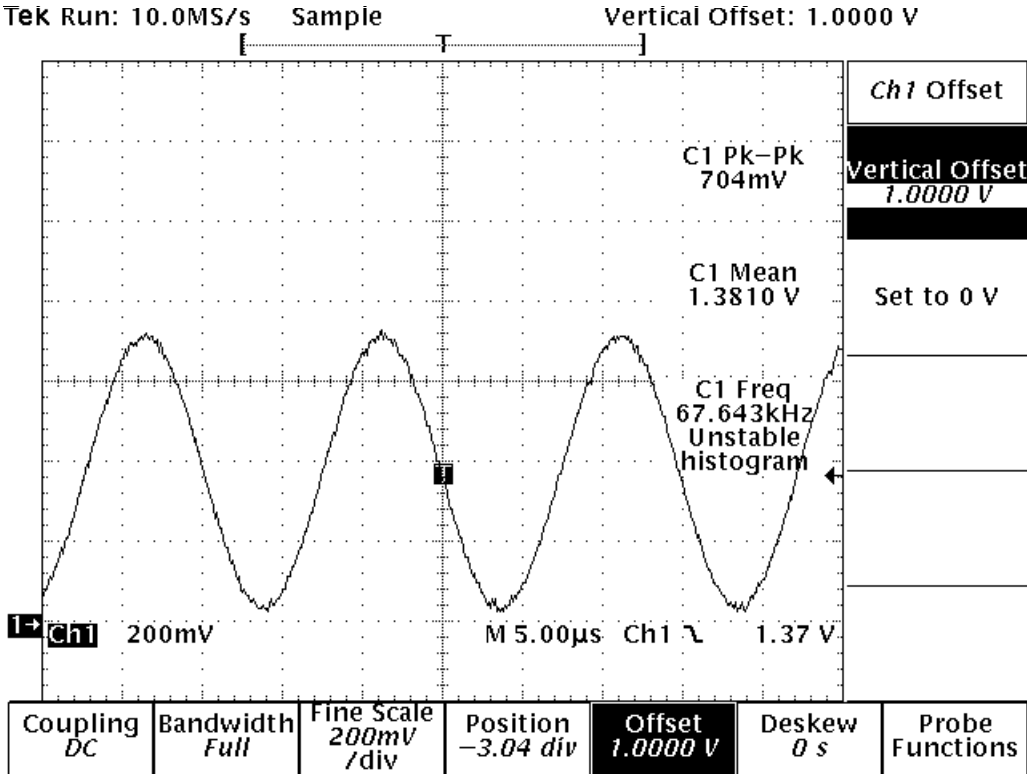

Figure 10: RX850 I/Q signal waveform

General Instructions for GSM 1900 Rx Troubleshooting

Use the following steps to troubleshoot the GSM 1900 Rx:

1. Connect the phone to a PC with the module test jig.
2. Start Phoenix, and establish a connection to the phone.
3. Open the **File** menu, and click **Scan for Product**.
4. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
5. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 1900
   - **Active Unit** = Rx
   - **Operation Mode** = Continuous

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- **Rx/Tx Channel** = 661
- **AGC** = 9

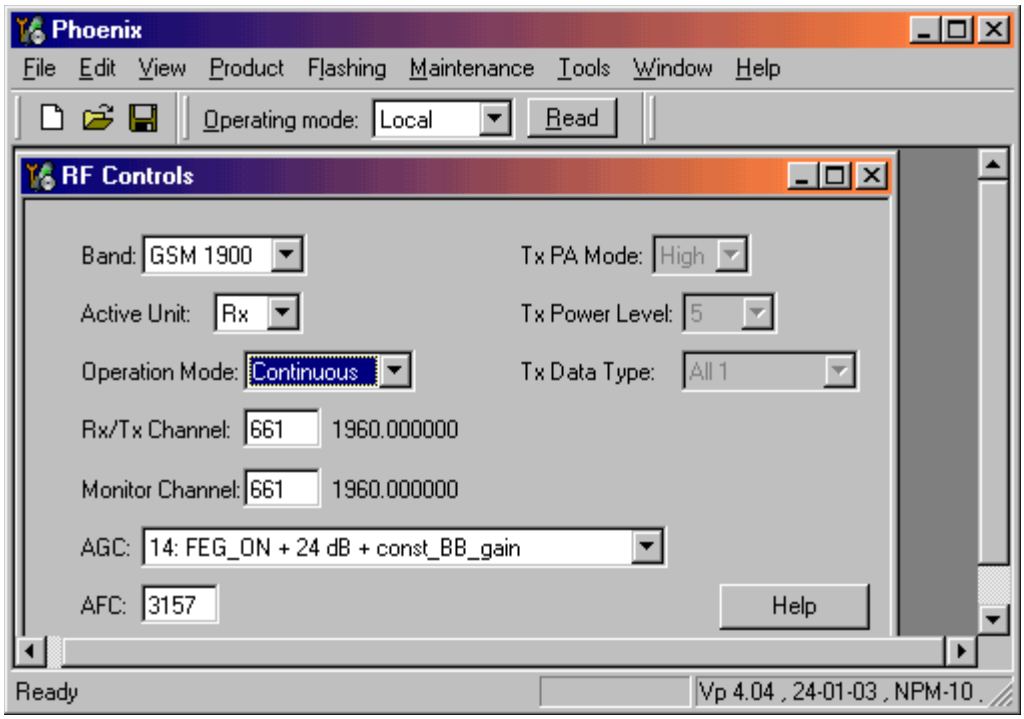

Figure 11: GSM 1900 values on the Rx RF Controls dialog box

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Troubleshooting Chart for PCS Receiver

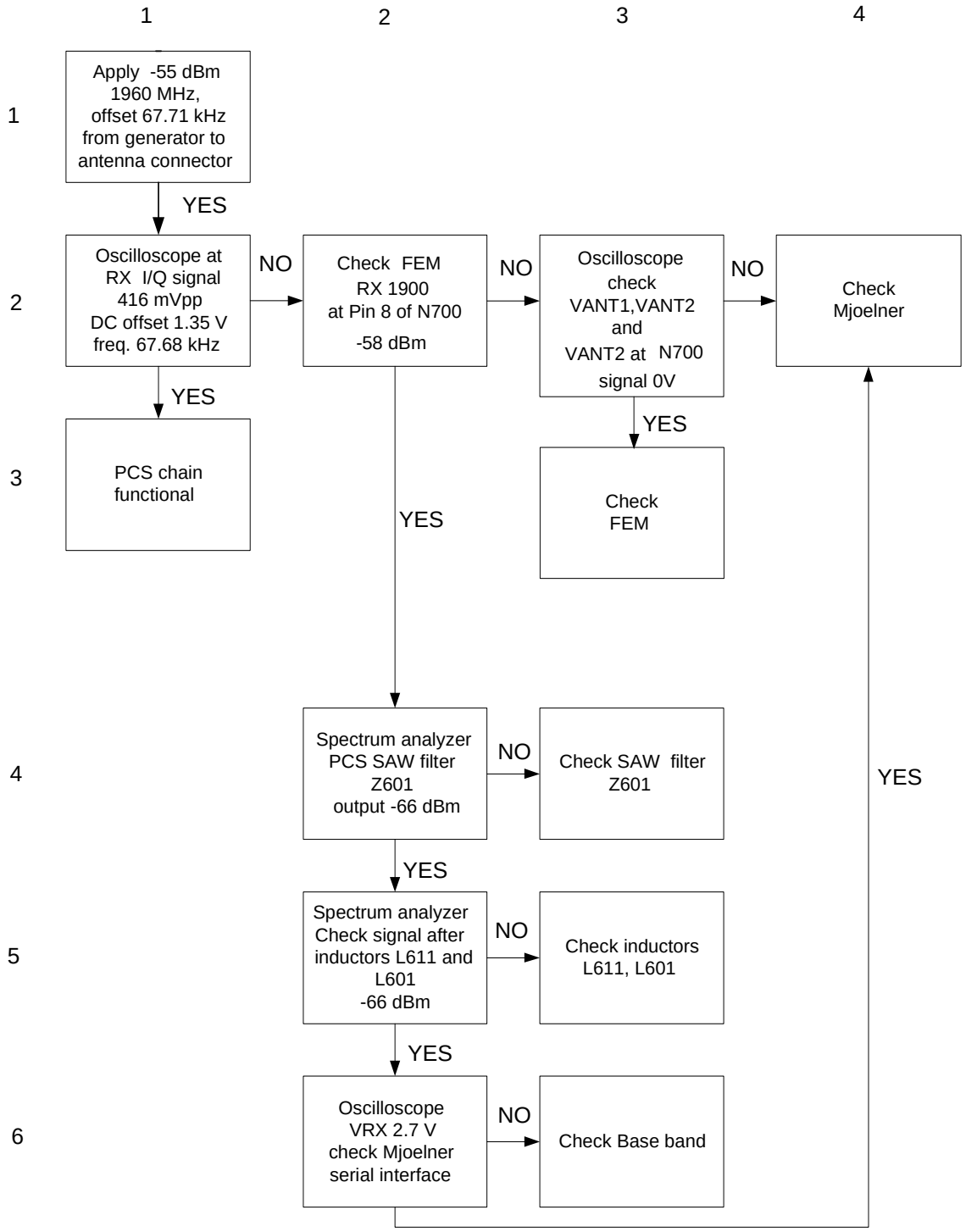

Figure 12: GSM 1900 receiver troubleshooting chart

Figure 13 shows the results of measuring with an oscilloscope at RXIP or RXQP on a working GSM 1900 receiver.

- Signal general frequency = 1960.06771 MHz
- Amplitude = -55 dBm
- Signal amplitude peak-peak 416 mV
- DC offset 1.35 V

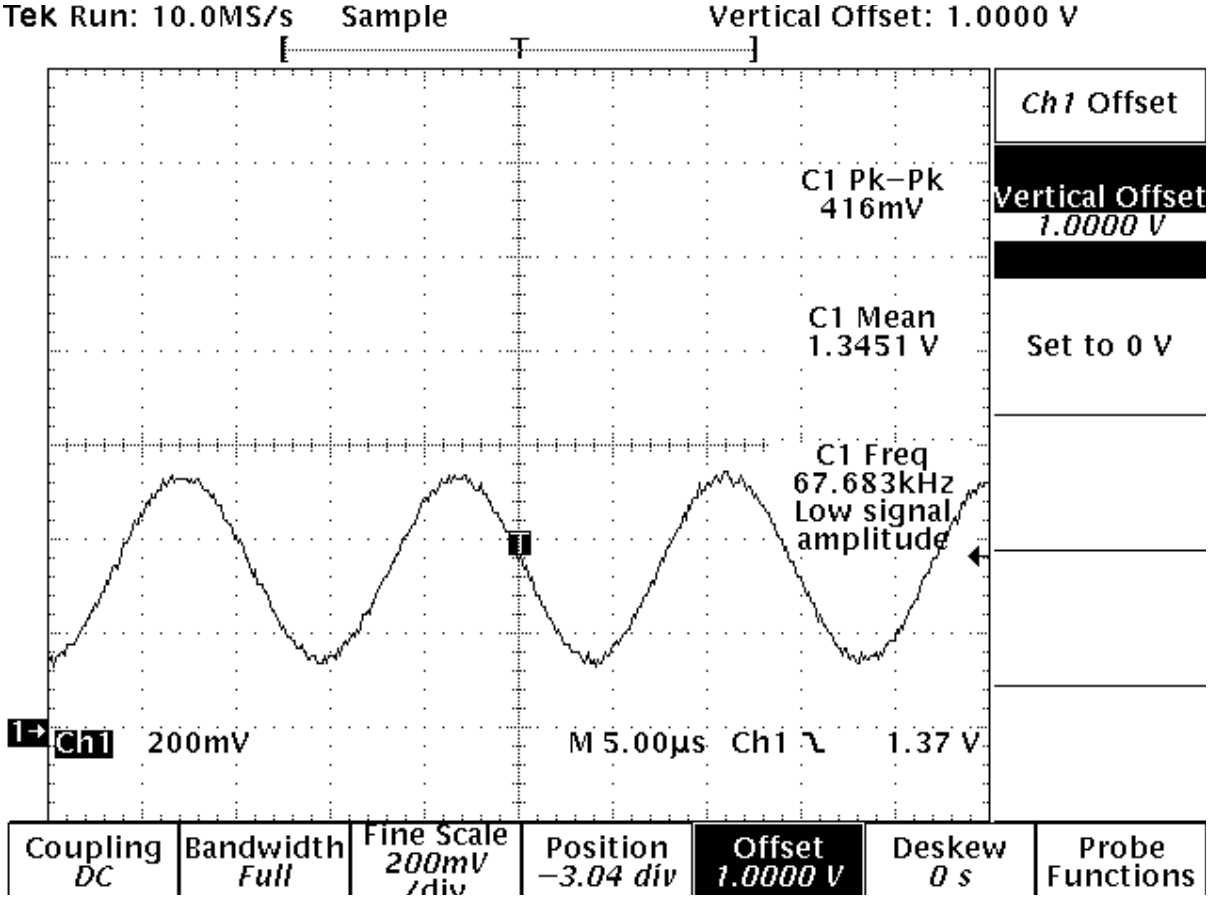

Figure 13: RX1900 I/Q signal waveform

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Measurement Points in the Receiver

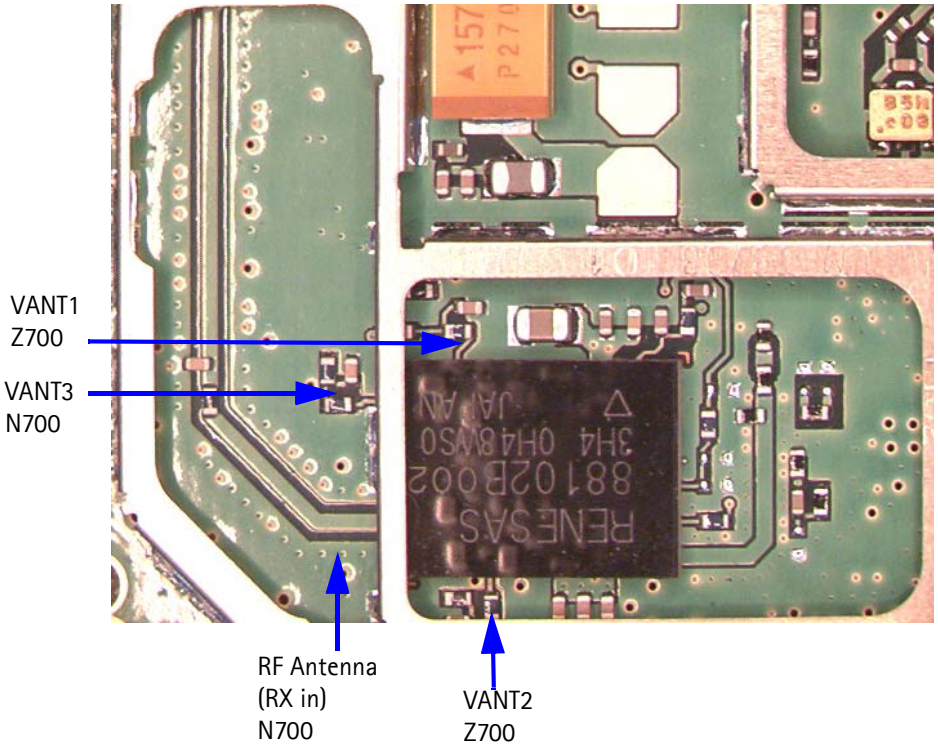

Figure 14: Rx measurement points at the front-end module PA (N700)

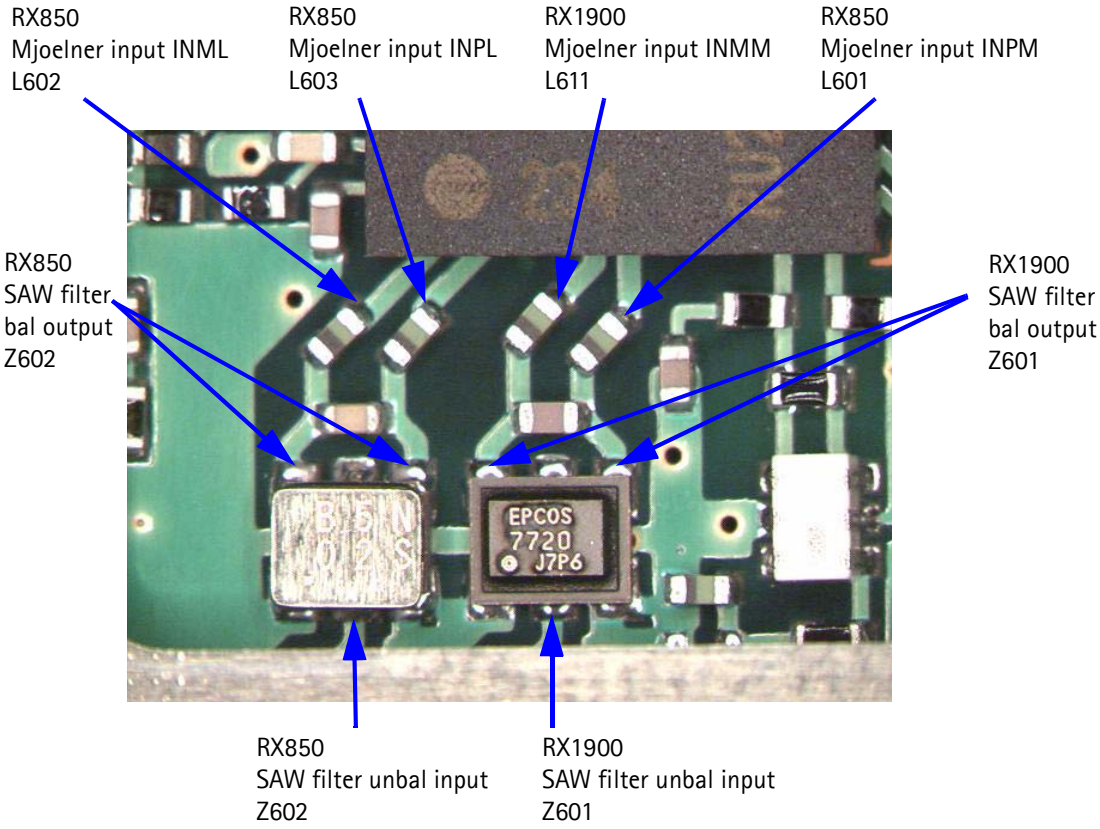

Figure 15: Measurement points at the Rx filters – Z601/Z602

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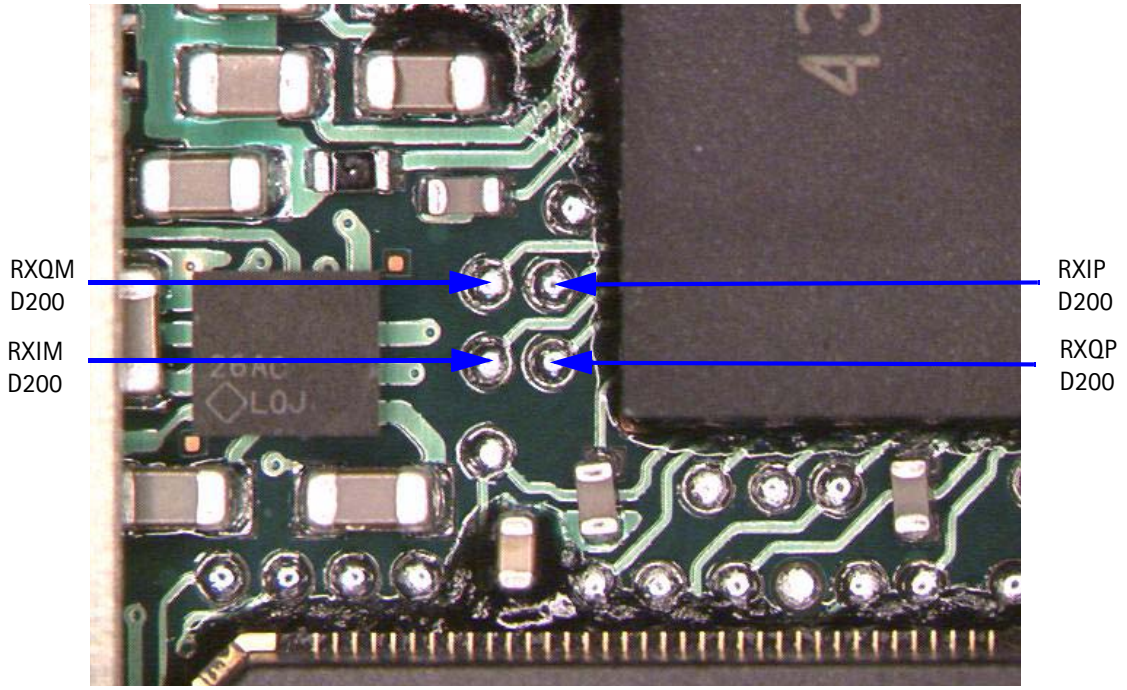

Figure 16: Rx I/Q Signals, baseband shielding can

Transmitter

Measurement Points for the Transmitter

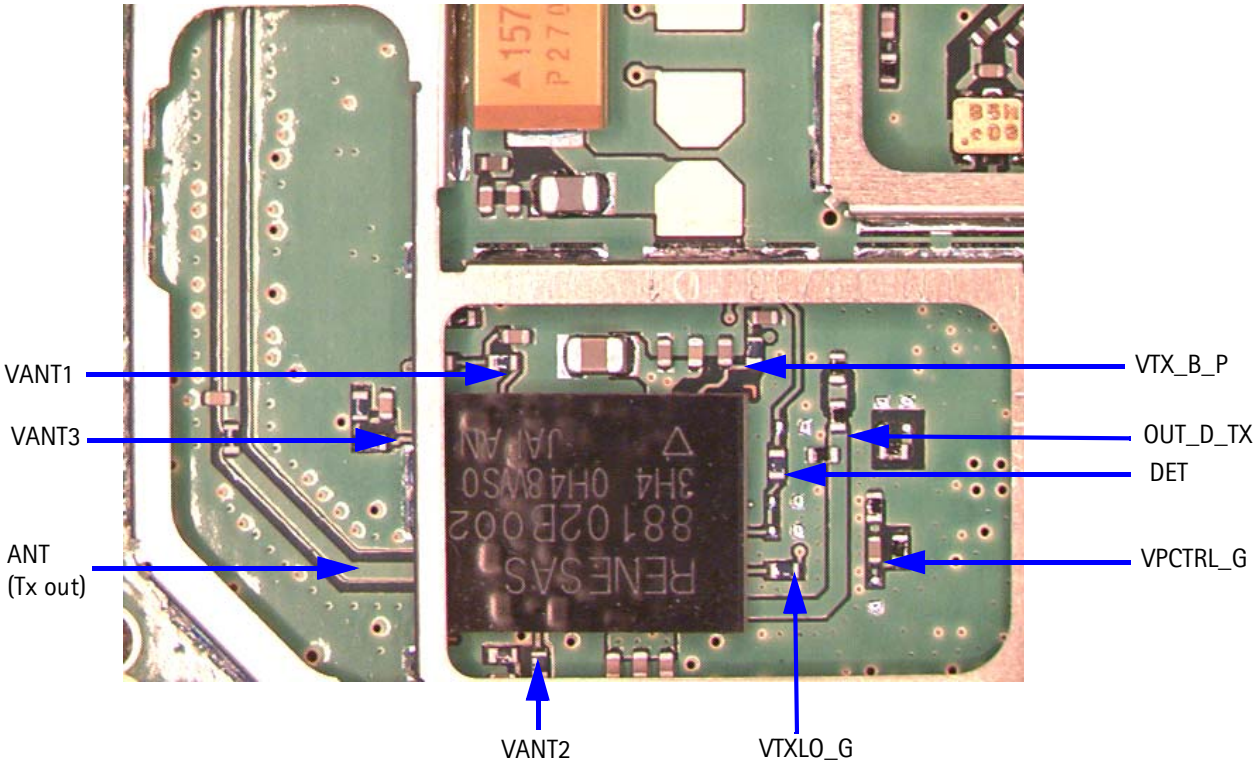

Figure 17: Tx measurement points in the PA (N700) shielding can

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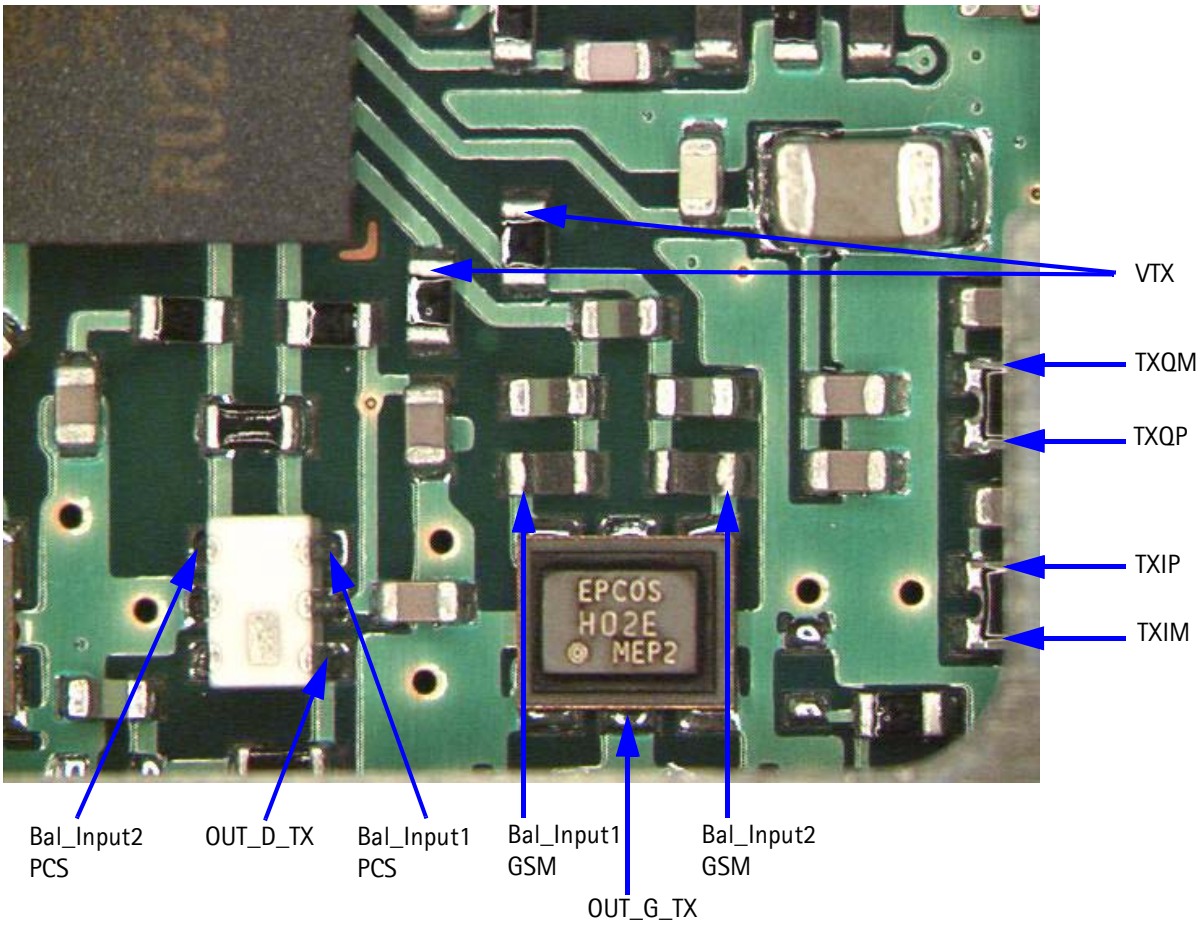

Figure 18: Tx measurement points in the Mjolner (N600) shielding can

General Instructions for GSM Tx Troubleshooting

Use the following steps to troubleshoot the GSM Tx:

1. Apply an RF cable to the RF connector to allow the transmitted signal to act as normal. The RF cable should be connected to measurement equipment with at least a 10 dB attenuator. Otherwise, the test equipment may be damaged.
2. Start Phoenix, and establish a connection to the phone (e.g., FBUS, MBUS).
3. Open the **File** menu, and click **Choose Product**.
4. Select **NPM-10**.
5. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
6. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 850
   - **Active Unit** = Tx
   - **Operation Mode** = Burst
   - **Rx/Tx Channel** = 190
   - **Tx PA Mode** = Free

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- **Tx Power Level** = 5
- **Tx Data Type** = All 1

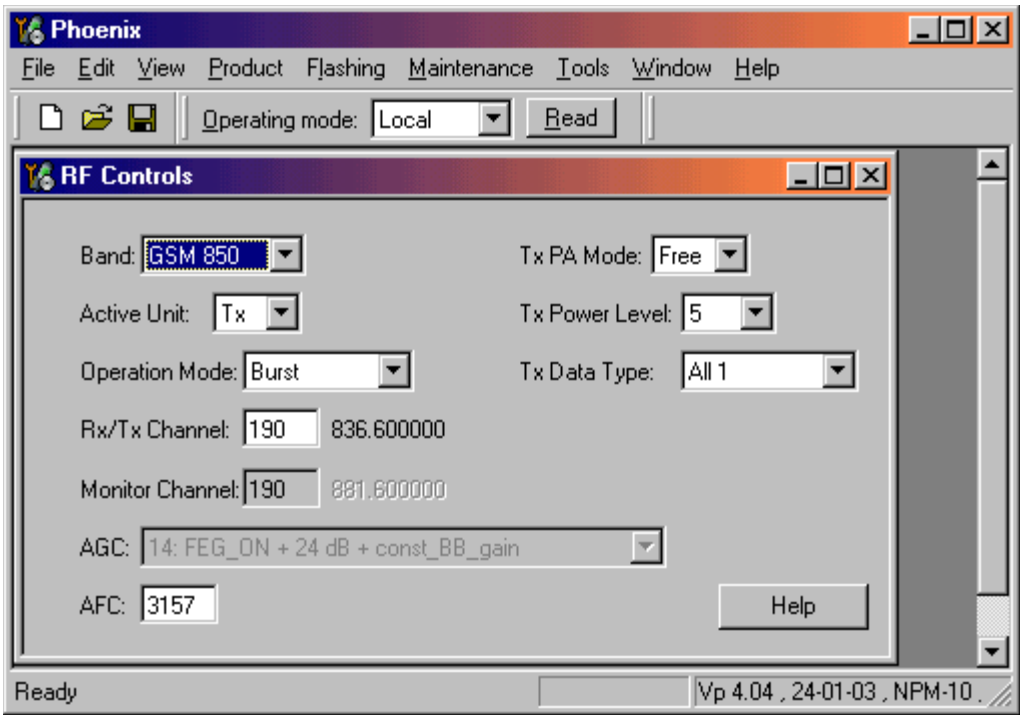

Figure 19: GSM Tx **values on the RF Controls dialog box**

7 Measure the output power of the phone; it should be around 32.0 dBm. Remember the loss along the end launch connector in the test jig (around 0.3 dB).

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Troubleshooting Chart for GSM 850 Transmitter

Use a high impedance probe for the spectrum analyzer measurements in the following chart. Set the trace to maxhold because the signal is bursted.

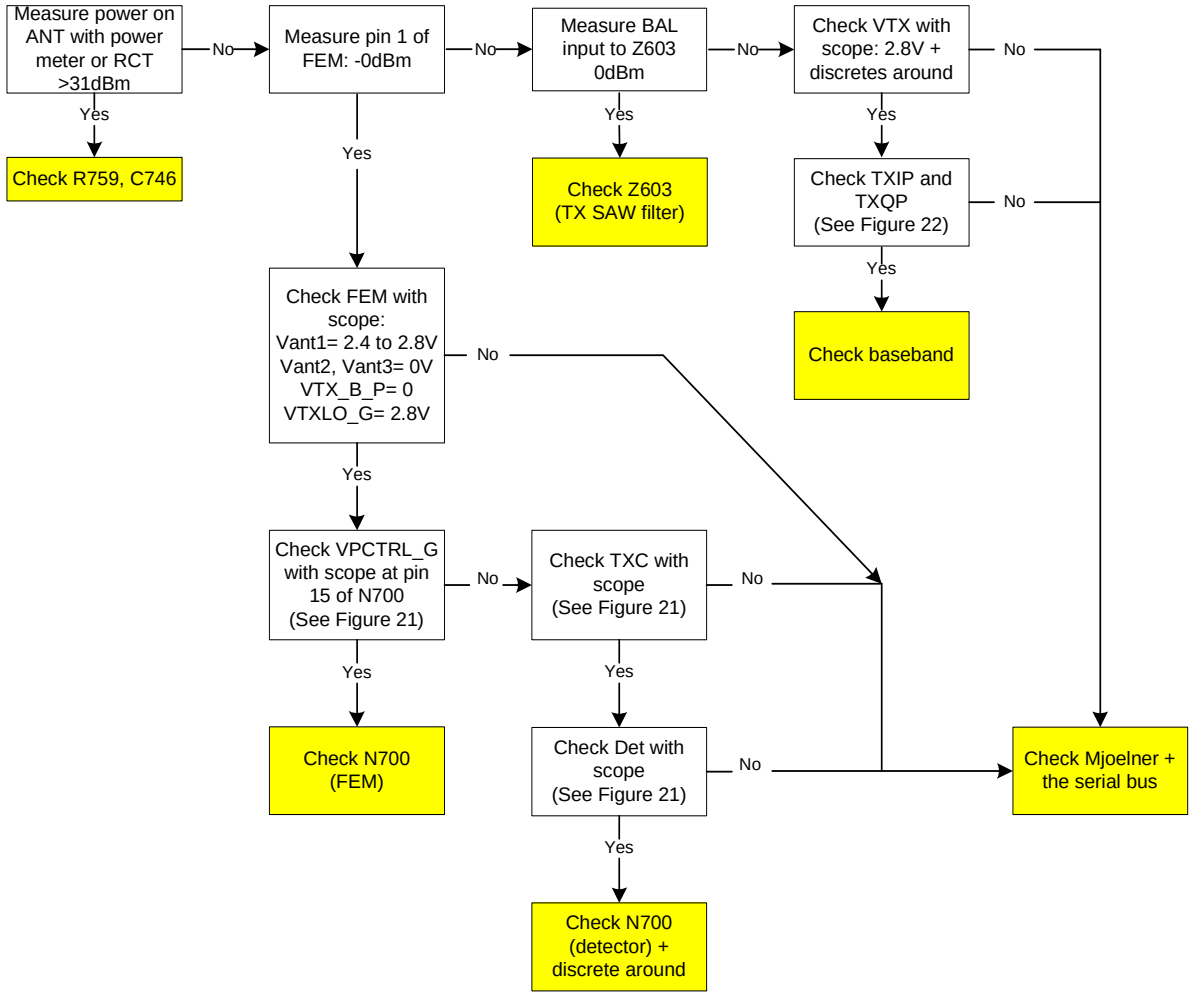

Figure 20: GSM 850 transmitter troubleshooting chart

The following apply to Figure 21:

- GSM 850 band, Power level 5, Channel 190
- Black trace: TXP
- Green trace: TXC
- Red trace: Vpctrl_G @ R713 output
- Blue trace: VDet_G @ R704 input

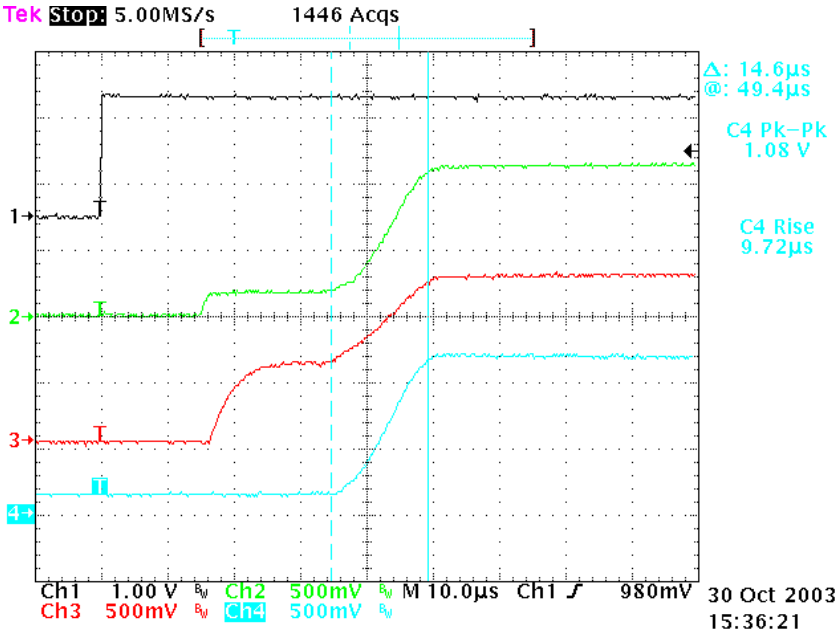

Figure 21: TXP, VPCTRL_G and TXC

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Troubleshooting the Modulation

The following plots show different situations of Tx IQ measurements. Depending on the time, the modulation may cause the signal to look differently.

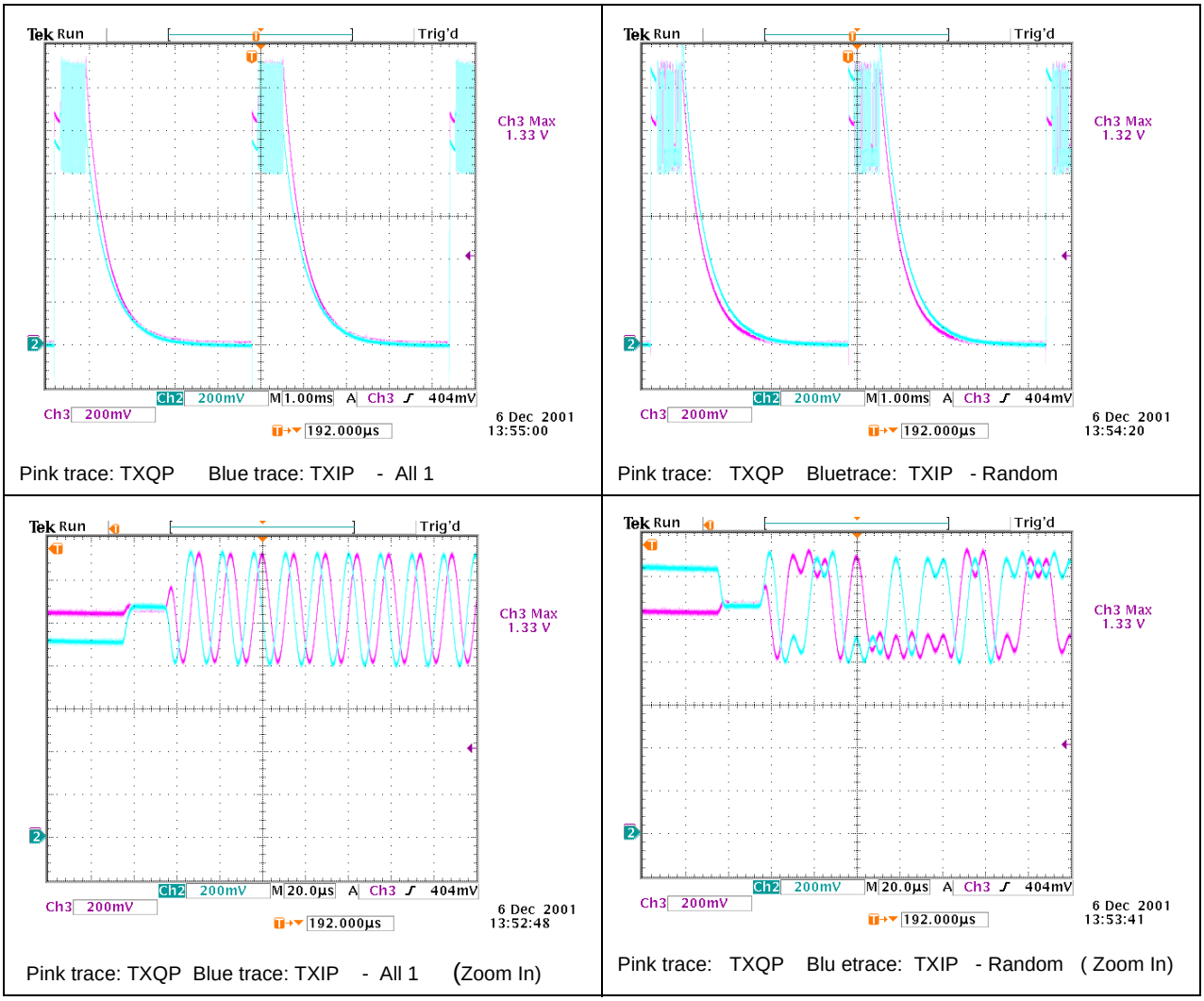

Figure 22: Tx I/Q waveforms

I/Q signals look almost the same regardless if modulation is by "1" or by "0". There is no significant difference between TXIP and TXIM. The same is valid for TXQP and TXQM.

General instructions for PCS Tx troubleshooting

Use the following steps to troubleshoot the PCS Tx:

1. Apply an RF cable to the RF connector to allow the transmitted signal to act as normal. The RF cable should be connected to measurement equipment or at least to a 10 dB attenuator. Otherwise, the test equipment may be damaged.
2. Start Phoenix, and establish a connection to the phone (e.g., FBUS).
3. Open the **File** menu, and click **Choose Product**.
4. Select **NPM-10**.
5. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.

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6. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 1900
   - **Active Unit** = Tx
   - **Tx Power Level** = 0
   - **Tx Data Type** = All 1

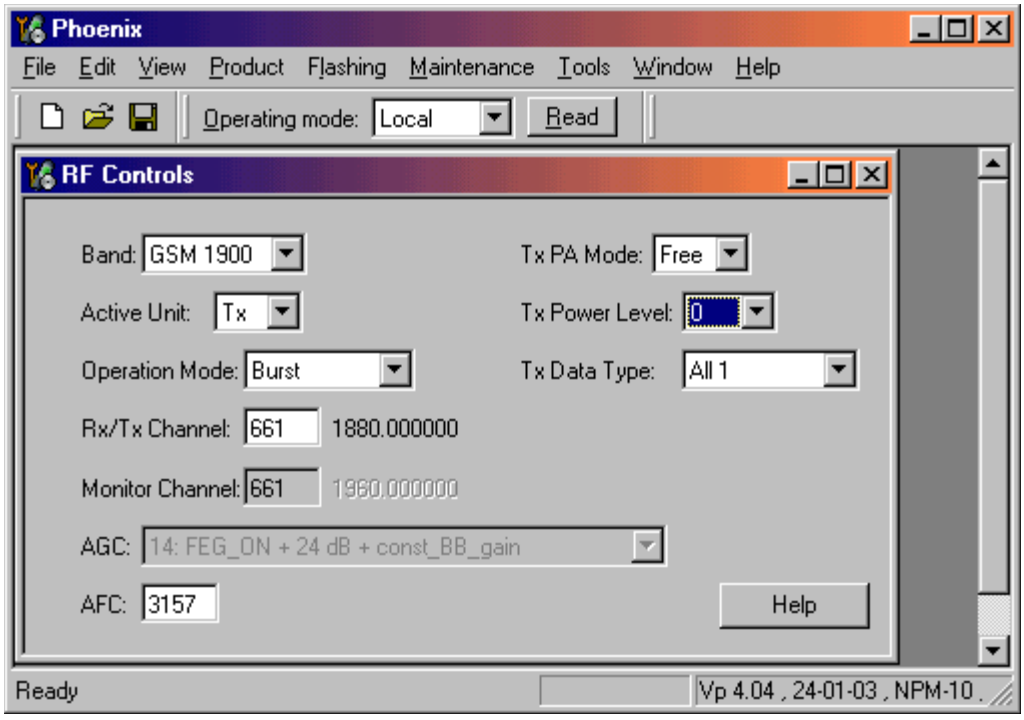

Figure 23: PCS Tx values on the RF Controls dialog box

7. Measure the output power of the phone; it should be around 29.5 dBm. Remember the loss in the test jig (around 0.7 dB).

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Figure 24 shows a troubleshooting chart for the PCS transmitter

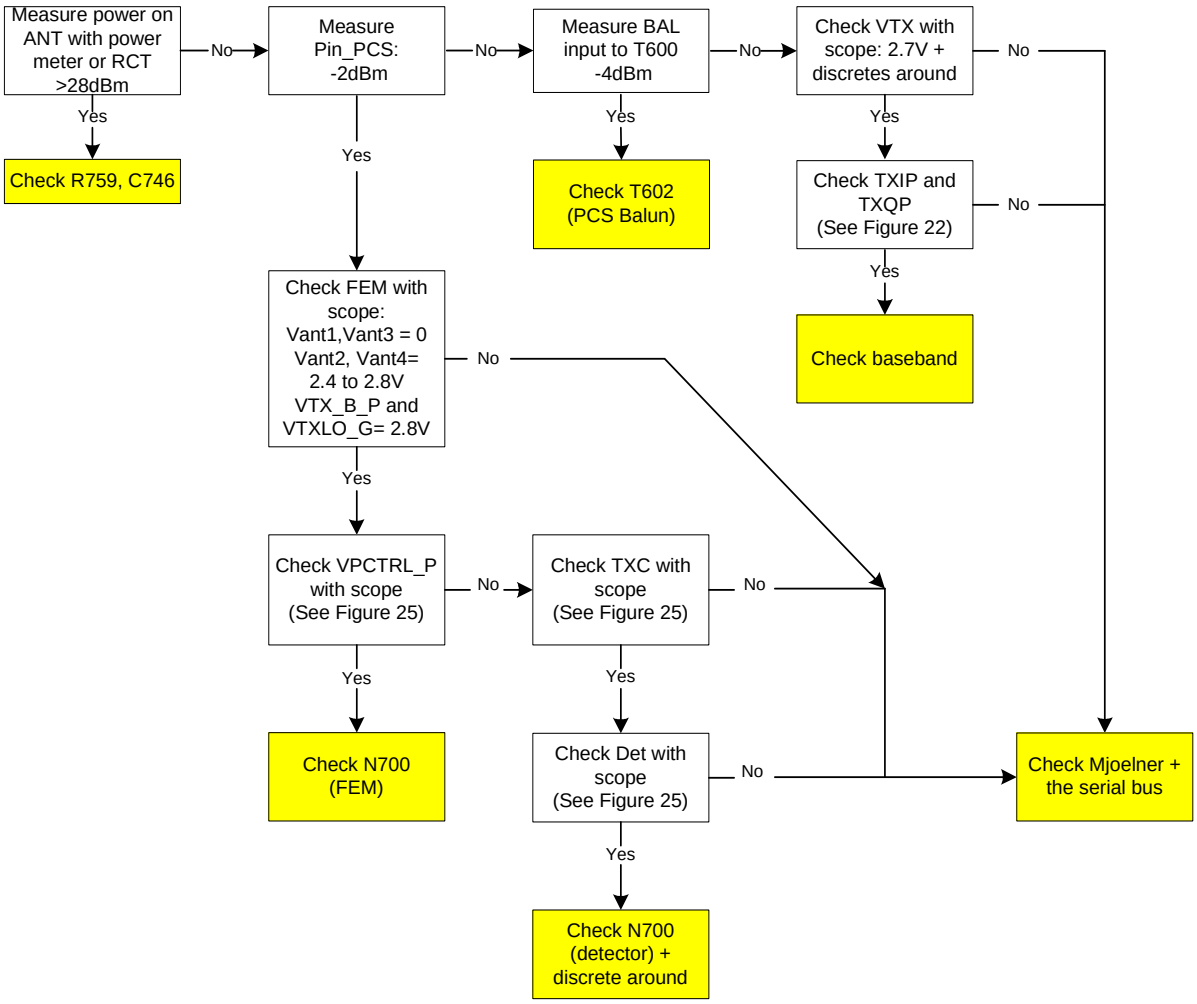

Figure 24: GSM 1900 transmitter troubleshooting chart

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The following applies to Figure 25:

- PCS 1900 band, Power level 0, Channel 661
- Red trace: Vpctrl_P @ R713 output

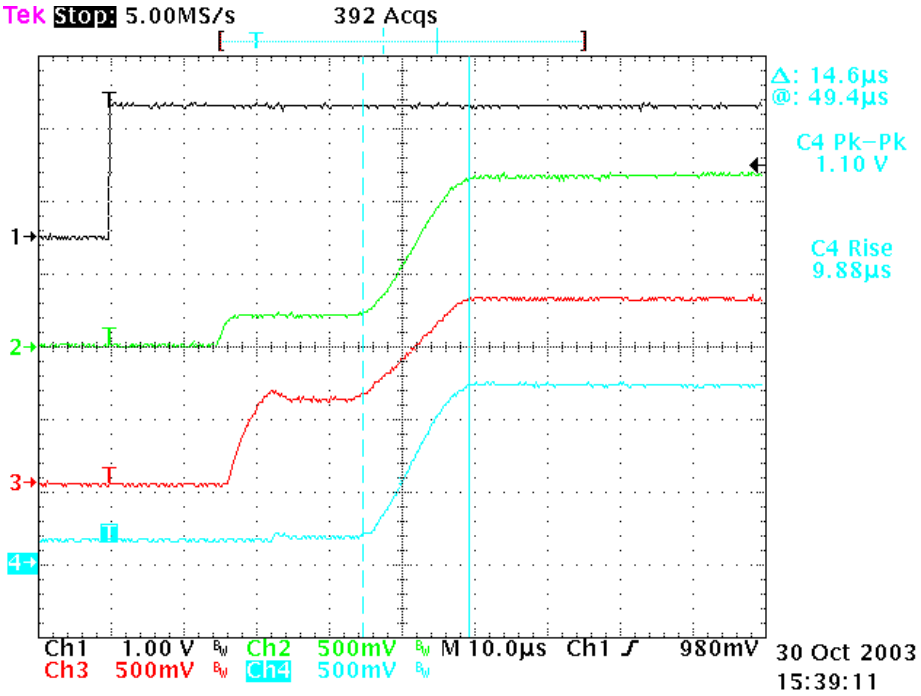

Figure 25: VPCTRL_P

Note: TXIQ signals look the same in PCS and GSM

Synthesizer

There is only one PLL synthesizer generating local oscillator frequencies for both the Rx and Tx in both bands (PCS and GSM). The VCO frequency is divided by two for PCS operation or by four for GSM operation inside the Mjoelner IC.

General Instructions for Synthesizer Troubleshooting

Use the following steps to troubleshoot the synthesizer:

1. Start Phoenix, and establish a connection to the phone.
2. Open the **File** menu, and click **Choose Product**.
3. Select **NPM-10**.
4. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
5. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 1900
   - **Active Unit** = Rx

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- **Operation Mode** = Continuous
- **Rx/Tx Channel** = 661

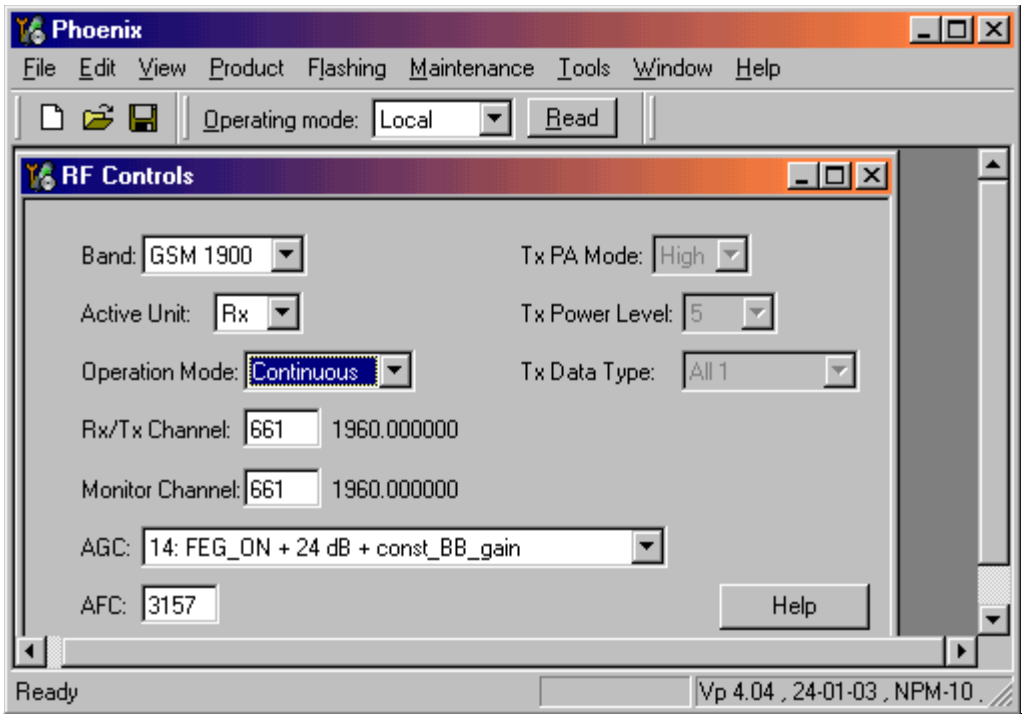

Figure 26: Synthesizer values on the RF Controls dialog box

It is not possible to measure the output of the VCO (G600) directly because this component is placed underneath a shielding can without a detachable lid. However, it is possible to get an indication if the VCO outputs the correct frequency with a spectrum analyzer and a high impedance probe. To do this, probe R656 and C654. The frequency should be 3920 MHz and the power should be around –50 dBm.

26 MHz Reference Oscillator (VCXO)

The 26 MHz oscillator is located in the Mjoelner IC (N600). The coarse frequency for this oscillator is set by an external crystal (B600). The oscillator is used as a reference frequency for the PLL synthesizer and as the system clock for the baseband. The 26 MHz signal is divided by two to achieve 13 MHz inside the UPP IC (D400). The 26 MHz signal from the VCXO can be measured by probing R420 (measure on the UPP side of R420, which is the end that is **not** connected to C420). The level at this point is approximately 700 mVpp. The frequency of this oscillator is adjusted by changing the AFC-register inside the Mjoelner IC via the Mjoelner serial interface.

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Example Signal Measured at VCXO output (R420)

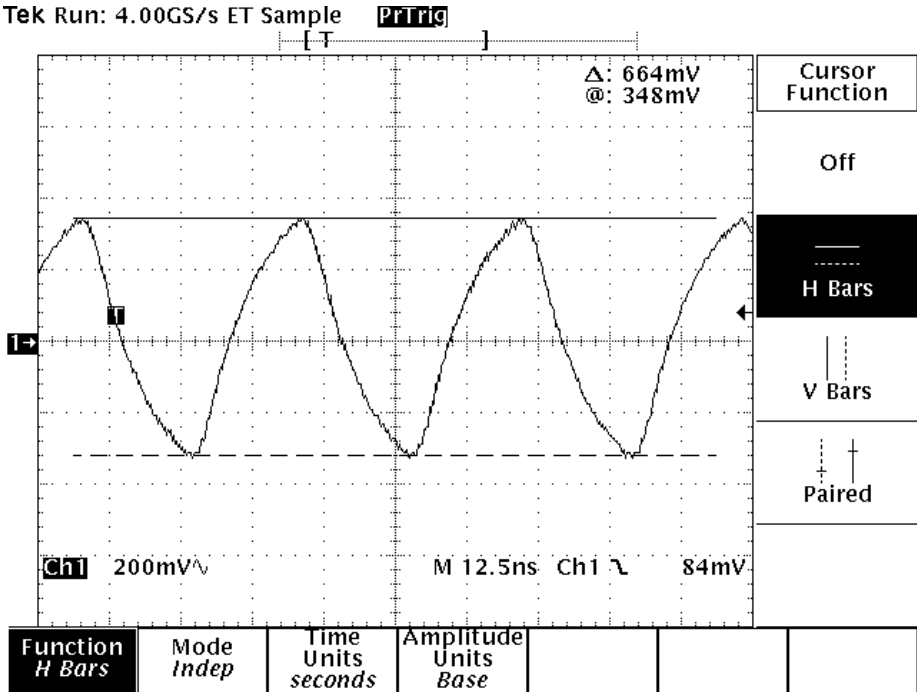

Figure 27: VCXO 26 MHz waveform

VCO

The VCO generates frequencies in the range of 3296.8 MHz–3979.6 MHz when the PLL is running. The output frequency from the VCO is led to the local oscillator input of the Mjoelner IC (N600), where the frequency is divided by two or four so that they can generate all channels in GSM and PCS respectively. The frequency of the VCO is controlled by a DC-voltage (Vctrl) coming from the loop filter. The loop filter consists of the R618, R619, and C639-C641 components. The Vctrl range when the PLL is running (locked) is 0.4 V–2.4 V. Even if the PLL is not in a locked state (the Vctrl is out of range), there is some frequency at the output of the VCO (G600), which is between 3 GHz and 4 GHz. This is only true if the VCO is working and if the VCO power supply is present (2.7 V).

Troubleshooting Chart for PLL Synthesizer

Use the following settings in Pheonix to troubleshoot the PLL synthesizer in Figure 29.

1. Open the **File** menu, and click **Choose Product**.
2. Select **NPM-10**.
3. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
4. Select the following values on the **RF Controls** dialog box:
   - **Band** = GSM 1900
   - **Active Unit** = Rx

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- **Operation Mode** = Continuous
- **Rx/Tx Channel** = 661

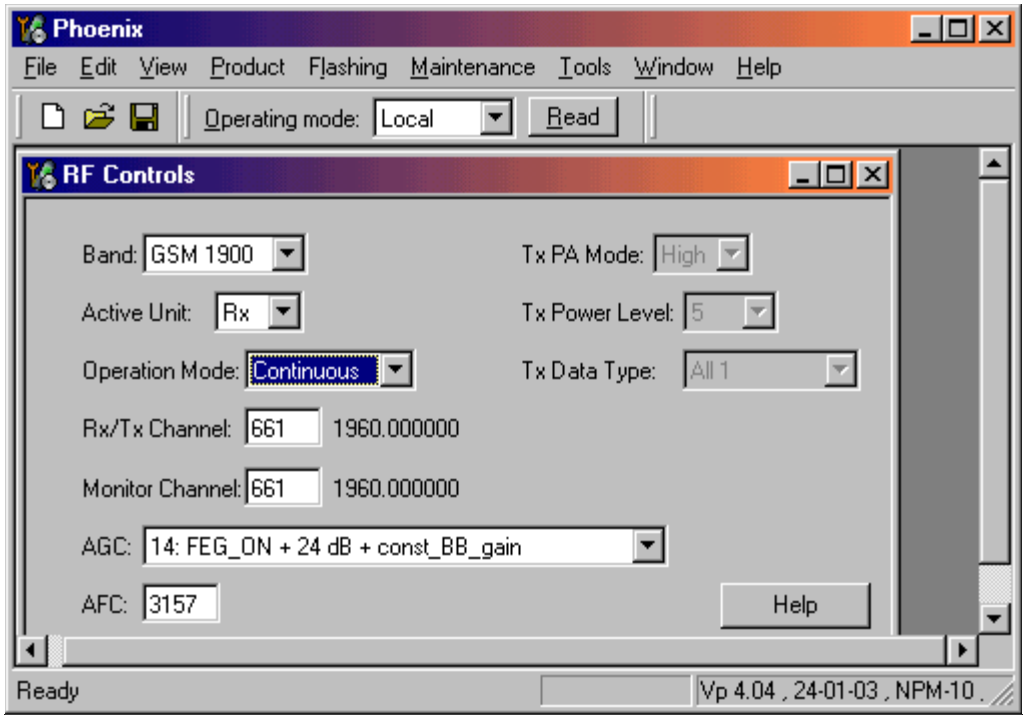

Figure 28: RF Controls settings for PLL troubleshooting

5. Troubleshoot using Figure 29.

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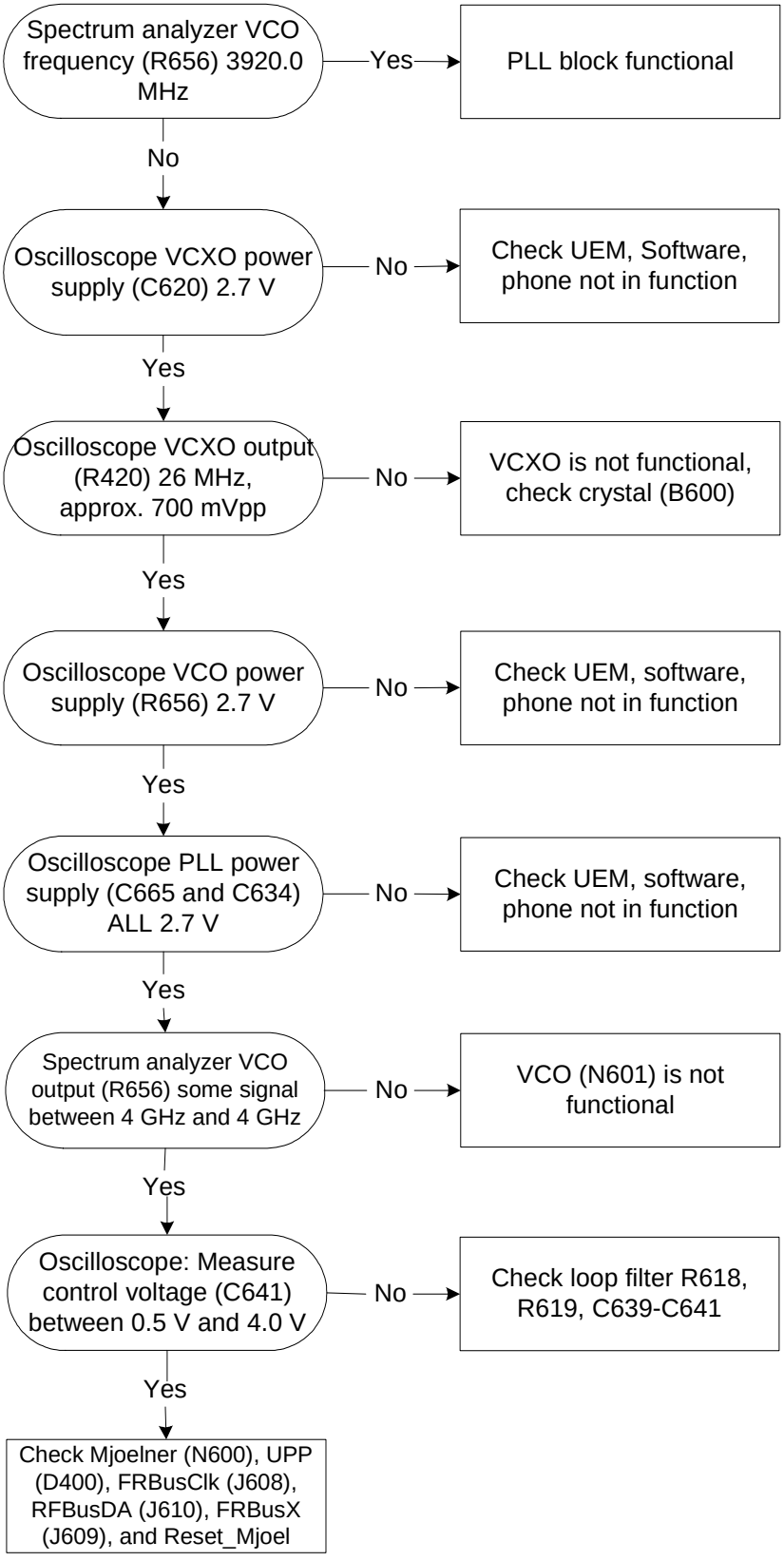
Spectrum analyzer VCO frequency (R656) 3920.0 MHz
Yes
PLL block functional
No
Oscilloscope VCXO power supply (C620) 2.7 V
No
Check UEM, Software, phone not in function
Yes
Oscilloscope VCXO output (R420) 26 MHz, approx. 700 mVpp
No
VCXO is not functional, check crystal (B600)
Yes
Oscilloscope VCO power supply (R656) 2.7 V
No
Check UEM, software, phone not in function
Yes
Oscilloscope PLL power supply (C665 and C634) ALL 2.7 V
No
Check UEM, software, phone not in function
Yes
Spectrum analyzer VCO output (R656) some signal between 4 GHz and 4 GHz
No
VCO (N601) is not functional
Yes
Oscilloscope: Measure control voltage (C641) between 0.5 V and 4.0 V
No
Check loop filter R618, R619, C639-C641
Yes
Check Mjoelner (N600), UPP (D400), FRBusClk (J608), RFBusDA (J610), FRBusX (J609), and Reset_Mjoel

Figure 29: PLL troubleshooting chart

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If the phone stops working a short time after the power is turned ON, the 26 MHz system clock signal might not be getting to the UPP clock-input in the baseband. In this case, turn on the phone and verify the following:

- VCXO power supply (C620) = 2.7 V
- VCXO output (R420 – the end **not** connected to C420) is 26 MHz and approximately 700 mVpp

If this is not the case, check the reference crystal (B600), Mjoelner (N600), R420, R426, C420, and C426.

Measurement Points for the PLL

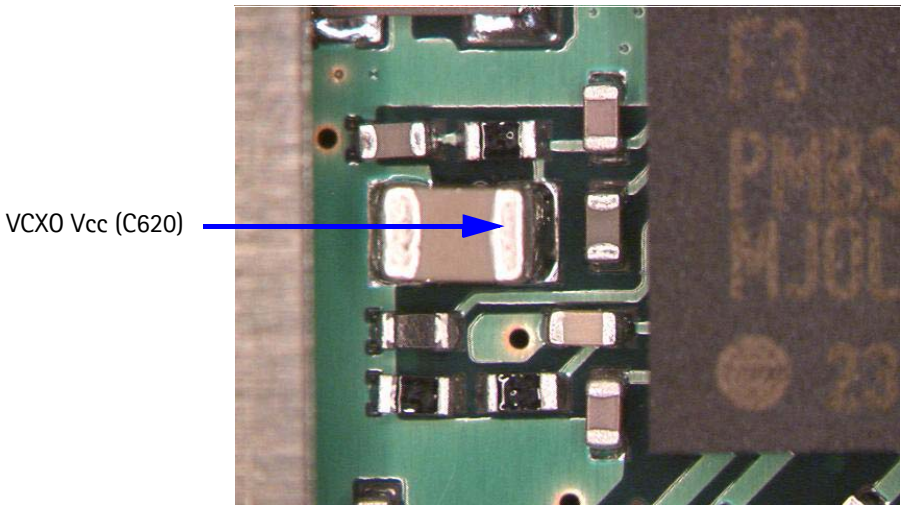

Figure 30: Measurement point for VCXO supply

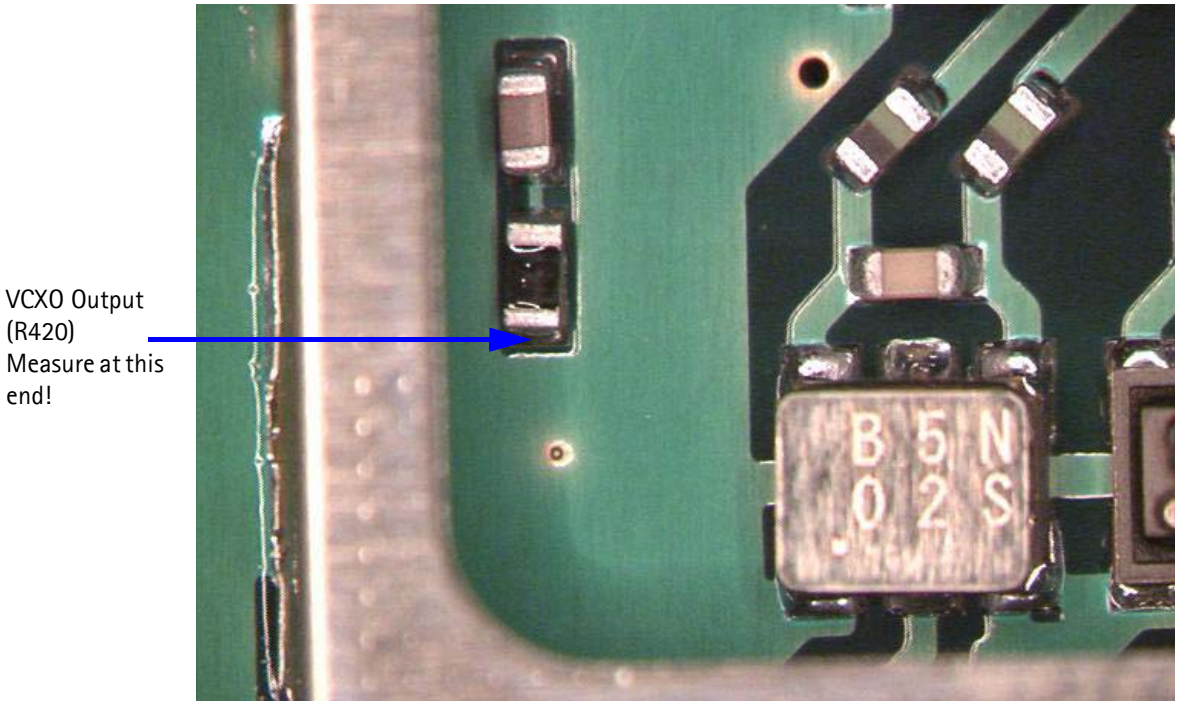

Figure 31: Measurement point for VCXO output

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Measurement Points at the PLL/VCO

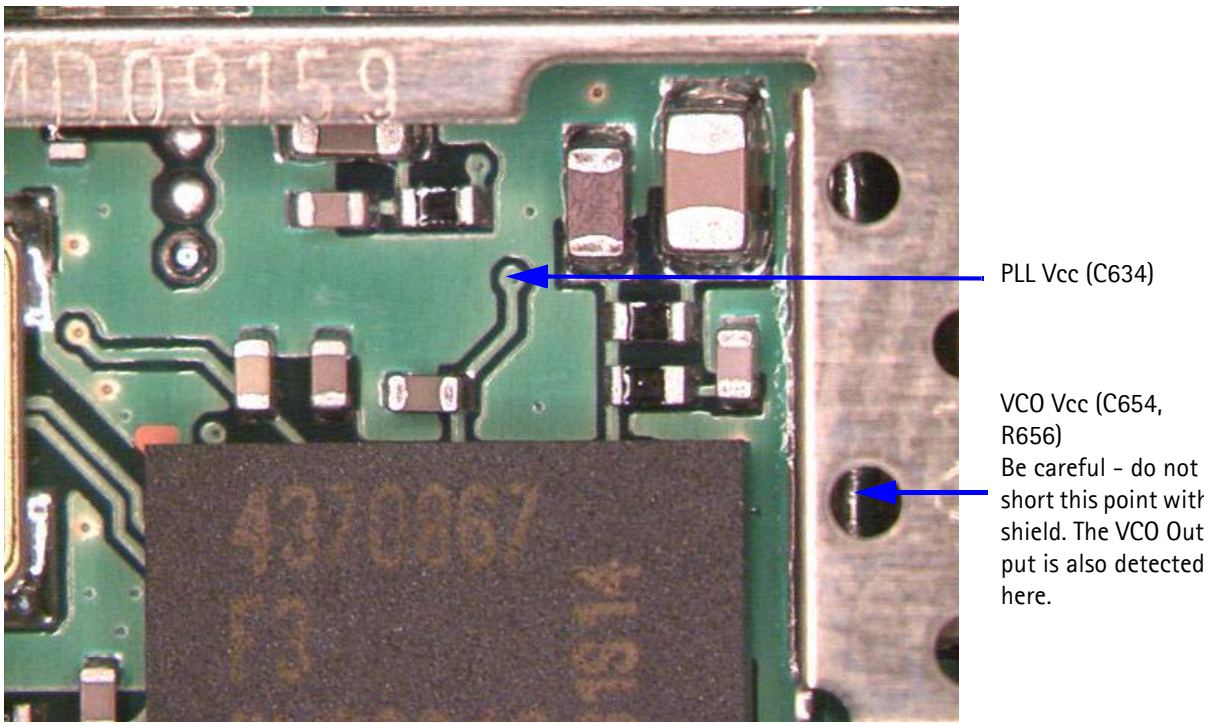

Figure 32: Measurement points at the PLL/VCO

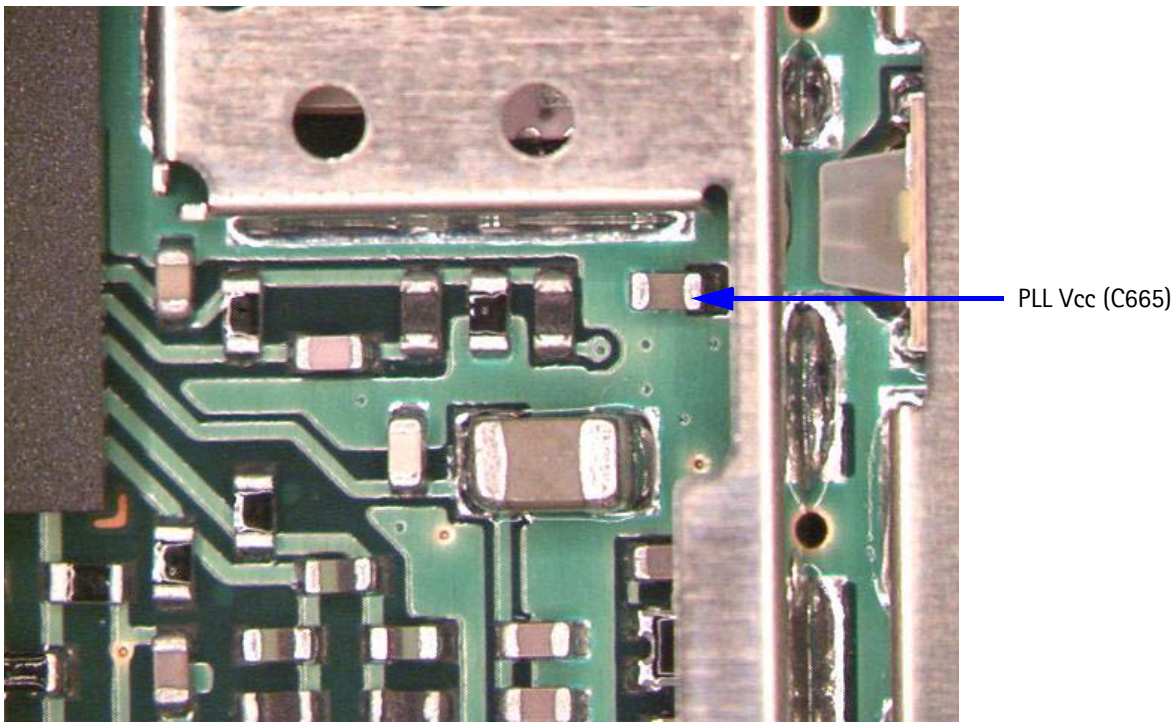

Figure 33: Measurement point for PLL

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Frequency Lists

GSM 850

Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	210	840.6	885.6	3362.4	3542.4
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	211	840.8	885.8	3363.2	3543.2
130	824.6	869.6	3298.4	3478.4	172	833	878	3332	3512	212	841	886	3364	3544
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	213	841.2	886.2	3364.8	3544.8
132	825	870	3300	3480	174	833.4	878.4	3333.6	3513.6	214	841.4	886.4	3365.6	3545.6
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	215	841.6	886.6	3366.4	3546.4
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	216	841.8	886.8	3367.2	3547.2
135	825.6	870.6	3302.4	3482.4	177	834	879	3336	3516	217	842	887	3368	3548
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	218	842.2	887.2	3368.8	3548.8
137	826	871	3304	3484	179	834.4	879.4	3337.6	3517.6	219	842.4	887.4	3369.6	3549.6
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	220	842.6	887.6	3370.4	3550.4
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	221	842.8	887.8	3371.2	3551.2
140	826.6	871.6	3306.4	3486.4	182	835	880	3340	3520	222	843	888	3372	3552
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	223	843.2	888.2	3372.8	3552.8
142	827	872	3308	3488	184	835.4	880.4	3341.6	3521.6	224	843.4	888.4	3373.6	3553.6
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	225	843.6	888.6	3374.4	3554.4
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	226	843.8	888.8	3375.2	3555.2
145	827.6	872.6	3310.4	3490.4	187	836	881	3344	3524	227	844	889	3376	3556
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	228	844.2	889.2	3376.8	3556.8
147	828	873	3312	3492	189	836.4	881.4	3345.6	3525.6	229	844.4	889.4	3377.6	3557.6
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	230	844.6	889.6	3378.4	3558.4
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	231	844.8	889.8	3379.2	3559.2
150	828.6	873.6	3314.4	3494.4	192	837	882	3348	3528	232	845	890	3380	3560
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	233	845.2	890.2	3380.8	3560.8
152	829	874	3316	3496	194	837.4	882.4	3349.6	3529.6	234	845.4	890.4	3381.6	3561.6
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	235	845.6	890.6	3382.4	3562.4
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	236	845.8	890.8	3383.2	3563.2
155	829.6	874.6	3318.4	3498.4	197	838	883	3352	3532	237	846	891	3384	3564
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	238	846.2	891.2	3384.8	3564.8
157	830	875	3320	3500	199	838.4	883.4	3353.6	3533.6	239	846.4	891.4	3385.6	3565.6
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	240	846.6	891.6	3386.4	3566.4
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	241	846.8	891.8	3387.2	3567.2
160	830.6	875.6	3322.4	3502.4	202	839	884	3356	3536	242	847	892	3388	3568
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	243	847.2	892.2	3388.8	3568.8
162	831	876	3324	3504	204	839.4	884.4	3357.6	3537.6	244	847.4	892.4	3389.6	3569.6
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	245	847.6	892.6	3390.4	3570.4
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	246	847.8	892.8	3391.2	3571.2
165	831.6	876.6	3326.4	3506.4	207	840	885	3360	3540	247	848	893	3392	3572
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	248	848.2	893.2	3392.8	3572.8
167	832	877	3328	3508	209	840.4	885.4	3361.6	3541.6	249	848.4	893.4	3393.6	3573.6
168	832.2	877.2	3328.8	3508.8						250	848.6	893.6	3394.4	3574.4
169	832.4	877.4	3329.6	3509.6						251	848.8	893.8	3395.2	3575.2

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PCS 1900

Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX
512	1850.2	1930.2	3700.4	3860.4	612	1870.2	1950.2	3740.4	3900.4	712	1890.2	1970.2	3780.4	3940.4
513	1850.4	1930.4	3700.8	3860.8	613	1870.4	1950.4	3740.8	3900.8	713	1890.4	1970.4	3780.8	3940.8
514	1850.6	1930.6	3701.2	3861.2	614	1870.6	1950.6	3741.2	3901.2	714	1890.6	1970.6	3781.2	3941.2
515	1850.8	1930.8	3701.6	3861.6	615	1870.8	1950.8	3741.6	3901.6	715	1890.8	1970.8	3781.6	3941.6
516	1851	1931	3702	3862	616	1871	1951	3742	3902	716	1891	1971	3782	3942
517	1851.2	1931.2	3702.4	3862.4	617	1871.2	1951.2	3742.4	3902.4	717	1891.2	1971.2	3782.4	3942.4
518	1851.4	1931.4	3702.8	3862.8	618	1871.4	1951.4	3742.8	3902.8	718	1891.4	1971.4	3782.8	3942.8
519	1851.6	1931.6	3703.2	3863.2	619	1871.6	1951.6	3743.2	3903.2	719	1891.6	1971.6	3783.2	3943.2
520	1851.8	1931.8	3703.6	3863.6	620	1871.8	1951.8	3743.6	3903.6	720	1891.8	1971.8	3783.6	3943.6
521	1852	1932	3704	3864	621	1872	1952	3744	3904	721	1892	1972	3784	3944
522	1852.2	1932.2	3704.4	3864.4	622	1872.2	1952.2	3744.4	3904.4	722	1892.2	1972.2	3784.4	3944.4
523	1852.4	1932.4	3704.8	3864.8	623	1872.4	1952.4	3744.8	3904.8	723	1892.4	1972.4	3784.8	3944.8
524	1852.6	1932.6	3705.2	3865.2	624	1872.6	1952.6	3745.2	3905.2	724	1892.6	1972.6	3785.2	3945.2
525	1852.8	1932.8	3705.6	3865.6	625	1872.8	1952.8	3745.6	3905.6	725	1892.8	1972.8	3785.6	3945.6
526	1853	1933	3706	3866	626	1873	1953	3746	3906	726	1893	1973	3786	3946
527	1853.2	1933.2	3706.4	3866.4	627	1873.2	1953.2	3746.4	3906.4	727	1893.2	1973.2	3786.4	3946.4
528	1853.4	1933.4	3706.8	3866.8	628	1873.4	1953.4	3746.8	3906.8	728	1893.4	1973.4	3786.8	3946.8
529	1853.6	1933.6	3707.2	3867.2	629	1873.6	1953.6	3747.2	3907.2	729	1893.6	1973.6	3787.2	3947.2
530	1853.8	1933.8	3707.6	3867.6	630	1873.8	1953.8	3747.6	3907.6	730	1893.8	1973.8	3787.6	3947.6
531	1854	1934	3708	3868	631	1874	1954	3748	3908	731	1894	1974	3788	3948
532	1854.2	1934.2	3708.4	3868.4	632	1874.2	1954.2	3748.4	3908.4	732	1894.2	1974.2	3788.4	3948.4
533	1854.4	1934.4	3708.8	3868.8	633	1874.4	1954.4	3748.8	3908.8	733	1894.4	1974.4	3788.8	3948.8
534	1854.6	1934.6	3709.2	3869.2	634	1874.6	1954.6	3749.2	3909.2	734	1894.6	1974.6	3789.2	3949.2
535	1854.8	1934.8	3709.6	3869.6	635	1874.8	1954.8	3749.6	3909.6	735	1894.8	1974.8	3789.6	3949.6
536	1855	1935	3710	3870	636	1875	1955	3750	3910	736	1895	1975	3790	3950
537	1855.2	1935.2	3710.4	3870.4	637	1875.2	1955.2	3750.4	3910.4	737	1895.2	1975.2	3790.4	3950.4
538	1855.4	1935.4	3710.8	3870.8	638	1875.4	1955.4	3750.8	3910.8	738	1895.4	1975.4	3790.8	3950.8
539	1855.6	1935.6	3711.2	3871.2	639	1875.6	1955.6	3751.2	3911.2	739	1895.6	1975.6	3791.2	3951.2
540	1855.8	1935.8	3711.6	3871.6	640	1875.8	1955.8	3751.6	3911.6	740	1895.8	1975.8	3791.6	3951.6
541	1856	1936	3712	3872	641	1876	1956	3752	3912	741	1896	1976	3792	3952
542	1856.2	1936.2	3712.4	3872.4	642	1876.2	1956.2	3752.4	3912.4	742	1896.2	1976.2	3792.4	3952.4
543	1856.4	1936.4	3712.8	3872.8	643	1876.4	1956.4	3752.8	3912.8	743	1896.4	1976.4	3792.8	3952.8
544	1856.6	1936.6	3713.2	3873.2	644	1876.6	1956.6	3753.2	3913.2	744	1896.6	1976.6	3793.2	3953.2
545	1856.8	1936.8	3713.6	3873.6	645	1876.8	1956.8	3753.6	3913.6	745	1896.8	1976.8	3793.6	3953.6
546	1857	1937	3714	3874	646	1877	1957	3754	3914	746	1897	1977	3794	3954
547	1857.2	1937.2	3714.4	3874.4	647	1877.2	1957.2	3754.4	3914.4	747	1897.2	1977.2	3794.4	3954.4
548	1857.4	1937.4	3714.8	3874.8	648	1877.4	1957.4	3754.8	3914.8	748	1897.4	1977.4	3794.8	3954.8
549	1857.6	1937.6	3715.2	3875.2	649	1877.6	1957.6	3755.2	3915.2	749	1897.6	1977.6	3795.2	3955.2
550	1857.8	1937.8	3715.6	3875.6	650	1877.8	1957.8	3755.6	3915.6	750	1897.8	1977.8	3795.6	3955.6
551	1858	1938	3716	3876	651	1878	1958	3756	3916	751	1898	1978	3796	3956
552	1858.2	1938.2	3716.4	3876.4	652	1878.2	1958.2	3756.4	3916.4	752	1898.2	1978.2	3796.4	3956.4
553	1858.4	1938.4	3716.8	3876.8	653	1878.4	1958.4	3756.8	3916.8	753	1898.4	1978.4	3796.8	3956.8
554	1858.6	1938.6	3717.2	3877.2	654	1878.6	1958.6	3757.2	3917.2	754	1898.6	1978.6	3797.2	3957.2
555	1858.8	1938.8	3717.6	3877.6	655	1878.8	1958.8	3757.6	3917.6	755	1898.8	1978.8	3797.6	3957.6
556	1859	1939	3718	3878	656	1879	1959	3758	3918	756	1899	1979	3798	3958
557	1859.2	1939.2	3718.4	3878.4	657	1879.2	1959.2	3758.4	3918.4	757	1899.2	1979.2	3798.4	3958.4
558	1859.4	1939.4	3718.8	3878.8	658	1879.4	1959.4	3758.8	3918.8	758	1899.4	1979.4	3798.8	3958.8
559	1859.6	1939.6	3719.2	3879.2	659	1879.6	1959.6	3759.2	3919.2	759	1899.6	1979.6	3799.2	3959.2
560	1859.8	1939.8	3719.6	3879.6	660	1879.8	1959.8	3759.6	3919.6	760	1899.8	1979.8	3799.6	3959.6
561	1860	1940	3720	3880	661	1880	1960	3760	3920	761	1900	1980	3800	3960

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Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX	Ch	TX	RX	VCO TX	VCO RX
562	1860.2	1940.2	3720.4	3880.4	662	1880.2	1960.2	3760.4	3920.4	762	1900.2	1980.2	3800.4	3960.4
563	1860.4	1940.4	3720.8	3880.8	663	1880.4	1960.4	3760.8	3920.8	763	1900.4	1980.4	3800.8	3960.8
564	1860.6	1940.6	3721.2	3881.2	664	1880.6	1960.6	3761.2	3921.2	764	1900.6	1980.6	3801.2	3961.2
565	1860.8	1940.8	3721.6	3881.6	665	1880.8	1960.8	3761.6	3921.6	765	1900.8	1980.8	3801.6	3961.6
566	1861	1941	3722	3882	666	1881	1961	3762	3922	766	1901	1981	3802	3962
567	1861.2	1941.2	3722.4	3882.4	667	1881.2	1961.2	3762.4	3922.4	767	1901.2	1981.2	3802.4	3962.4
568	1861.4	1941.4	3722.8	3882.8	668	1881.4	1961.4	3762.8	3922.8	768	1901.4	1981.4	3802.8	3962.8
569	1861.6	1941.6	3723.2	3883.2	669	1881.6	1961.6	3763.2	3923.2	769	1901.6	1981.6	3803.2	3963.2
570	1861.8	1941.8	3723.6	3883.6	670	1881.8	1961.8	3763.6	3923.6	770	1901.8	1981.8	3803.6	3963.6
571	1862	1942	3724	3884	671	1882	1962	3764	3924	771	1902	1982	3804	3964
572	1862.2	1942.2	3724.4	3884.4	672	1882.2	1962.2	3764.4	3924.4	772	1902.2	1982.2	3804.4	3964.4
573	1862.4	1942.4	3724.8	3884.8	673	1882.4	1962.4	3764.8	3924.8	773	1902.4	1982.4	3804.8	3964.8
574	1862.6	1942.6	3725.2	3885.2	674	1882.6	1962.6	3765.2	3925.2	774	1902.6	1982.6	3805.2	3965.2
575	1862.8	1942.8	3725.6	3885.6	675	1882.8	1962.8	3765.6	3925.6	775	1902.8	1982.8	3805.6	3965.6
576	1863	1943	3726	3886	676	1883	1963	3766	3926	776	1903	1983	3806	3966
577	1863.2	1943.2	3726.4	3886.4	677	1883.2	1963.2	3766.4	3926.4	777	1903.2	1983.2	3806.4	3966.4
578	1863.4	1943.4	3726.8	3886.8	678	1883.4	1963.4	3766.8	3926.8	778	1903.4	1983.4	3806.8	3966.8
579	1863.6	1943.6	3727.2	3887.2	679	1883.6	1963.6	3767.2	3927.2	779	1903.6	1983.6	3807.2	3967.2
580	1863.8	1943.8	3727.6	3887.6	680	1883.8	1963.8	3767.6	3927.6	780	1903.8	1983.8	3807.6	3967.6
581	1864	1944	3728	3888	681	1884	1964	3768	3928	781	1904	1984	3808	3968
582	1864.2	1944.2	3728.4	3888.4	682	1884.2	1964.2	3768.4	3928.4	782	1904.2	1984.2	3808.4	3968.4
583	1864.4	1944.4	3728.8	3888.8	683	1884.4	1964.4	3768.8	3928.8	783	1904.4	1984.4	3808.8	3968.8
584	1864.6	1944.6	3729.2	3889.2	684	1884.6	1964.6	3769.2	3929.2	784	1904.6	1984.6	3809.2	3969.2
585	1864.8	1944.8	3729.6	3889.6	685	1884.8	1964.8	3769.6	3929.6	785	1904.8	1984.8	3809.6	3969.6
586	1865	1945	3730	3890	686	1885	1965	3770	3930	786	1905	1985	3810	3970
587	1865.2	1945.2	3730.4	3890.4	687	1885.2	1965.2	3770.4	3930.4	787	1905.2	1985.2	3810.4	3970.4
588	1865.4	1945.4	3730.8	3890.8	688	1885.4	1965.4	3770.8	3930.8	788	1905.4	1985.4	3810.8	3970.8
589	1865.6	1945.6	3731.2	3891.2	689	1885.6	1965.6	3771.2	3931.2	789	1905.6	1985.6	3811.2	3971.2
590	1865.8	1945.8	3731.6	3891.6	690	1885.8	1965.8	3771.6	3931.6	790	1905.8	1985.8	3811.6	3971.6
591	1866	1946	3732	3892	691	1886	1966	3772	3932	791	1906	1986	3812	3972
592	1866.2	1946.2	3732.4	3892.4	692	1886.2	1966.2	3772.4	3932.4	792	1906.2	1986.2	3812.4	3972.4
593	1866.4	1946.4	3732.8	3892.8	693	1886.4	1966.4	3772.8	3932.8	793	1906.4	1986.4	3812.8	3972.8
594	1866.6	1946.6	3733.2	3893.2	694	1886.6	1966.6	3773.2	3933.2	794	1906.6	1986.6	3813.2	3973.2
595	1866.8	1946.8	3733.6	3893.6	695	1886.8	1966.8	3773.6	3933.6	795	1906.8	1986.8	3813.6	3973.6
596	1867	1947	3734	3894	696	1887	1967	3774	3934	796	1907	1987	3814	3974
597	1867.2	1947.2	3734.4	3894.4	697	1887.2	1967.2	3774.4	3934.4	797	1907.2	1987.2	3814.4	3974.4
598	1867.4	1947.4	3734.8	3894.8	698	1887.4	1967.4	3774.8	3934.8	798	1907.4	1987.4	3814.8	3974.8
599	1867.6	1947.6	3735.2	3895.2	699	1887.6	1967.6	3775.2	3935.2	799	1907.6	1987.6	3815.2	3975.2
600	1867.8	1947.8	3735.6	3895.6	700	1887.8	1967.8	3775.6	3935.6	800	1907.8	1987.8	3815.6	3975.6
601	1868	1948	3736	3896	701	1888	1968	3776	3936	801	1908	1988	3816	3976
602	1868.2	1948.2	3736.4	3896.4	702	1888.2	1968.2	3776.4	3936.4	802	1908.2	1988.2	3816.4	3976.4
603	1868.4	1948.4	3736.8	3896.8	703	1888.4	1968.4	3776.8	3936.8	803	1908.4	1988.4	3816.8	3976.8
604	1868.6	1948.6	3737.2	3897.2	704	1888.6	1968.6	3777.2	3937.2	804	1908.6	1988.6	3817.2	3977.2
605	1868.8	1948.8	3737.6	3897.6	705	1888.8	1968.8	3777.6	3937.6	805	1908.8	1988.8	3817.6	3977.6
606	1869	1949	3738	3898	706	1889	1969	3778	3938	806	1909	1989	3818	3978
607	1869.2	1949.2	3738.4	3898.4	707	1889.2	1969.2	3778.4	3938.4	807	1909.2	1989.2	3818.4	3978.4
608	1869.4	1949.4	3738.8	3898.8	708	1889.4	1969.4	3778.8	3938.8	808	1909.4	1989.4	3818.8	3978.8
609	1869.6	1949.6	3739.2	3899.2	709	1889.6	1969.6	3779.2	3939.2	809	1909.6	1989.6	3819.2	3979.2
610	1869.8	1949.8	3739.6	3899.6	710	1889.8	1969.8	3779.6	3939.6	810	1909.8	1989.8	3819.6	3979.6
611	1870	1950	3740	3900	711	1890	1970	3780	3940					

Alignment

NPM-10 (3595) Manual Align with Phoenix

Use the following steps to manually align the NPM-10 (3595).

Note: The alignments and calibrations must be performed in the order shown to give reliable results.

1. Start Phoenix, and establish a connection to the phone via FBUS. If you power up the powerboard before selecting FBUS, it works without any error messages.
2. Use a test jig or other device for the RF and bus connection.

3. Open the **File** menu, and click **Choose Product**.
4. Select **NPM-10**.
5. Attenuation in the test jig RF connector alone is 0.3 dB for GSM 850 and 0.7 dB for GSM1900.
6. Use an RCT (radio communication tester), spectrum analyzer, or another suitable device for tuning or testing the phone. The default channels are 190 for GSM 850 and 661 for GSM 1900.

Saving data to the phone and loading data from the phone are different processes in the various tuning procedures. Always look at what is shown in the windows regarding these issues and act accordingly.

Rx Calibration

Use the following steps to calibrate the Rx:

1. Open the **Maintenance** menu, point to **Tuning**, and click **Rx Calibration**.
2. Select GSM 850 in the **Band** field on the **Rx Calibration** dialog box. The GSM 850 must be calibrated before the PCS 1900.
3. Click the **Calibrate** button.

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Figure 34 shows the current values stored in permanent memory.

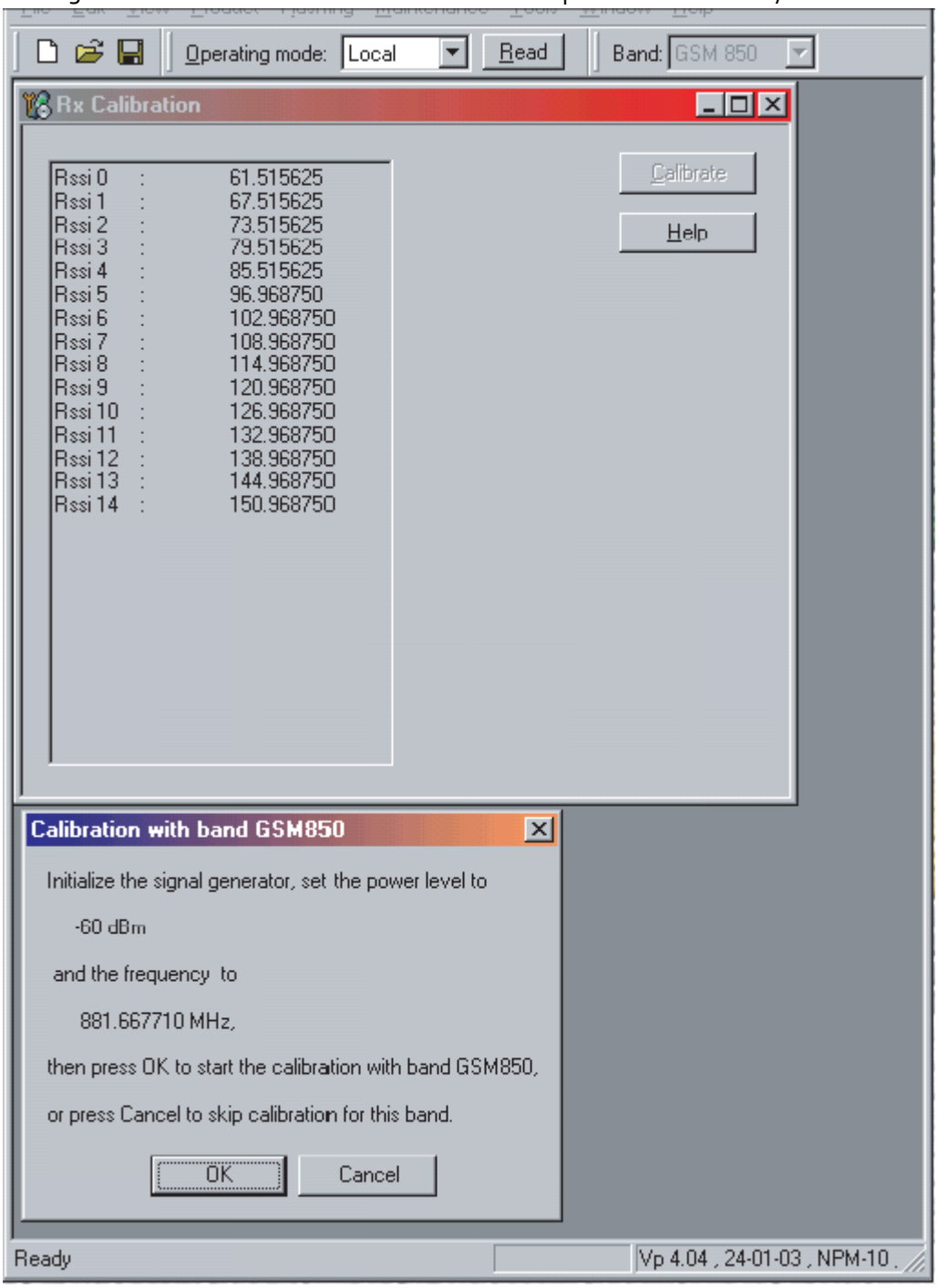

Figure 34: Rx Band GSM 850 calibration values

4. Adjust the signal generator settings to the frequency and amplitude specified in the **Calibration with band GSM850** message box.
5. Click **OK**. The 850 band is calibrated and automatically stored in PM.
6. Phoenix prompts for the 1900 MHz calibration while displaying the current values in PM.

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7. Adjust the signal generator settings to the frequency and amplitude specified in the **Calibration with band GSM 1900** message box.

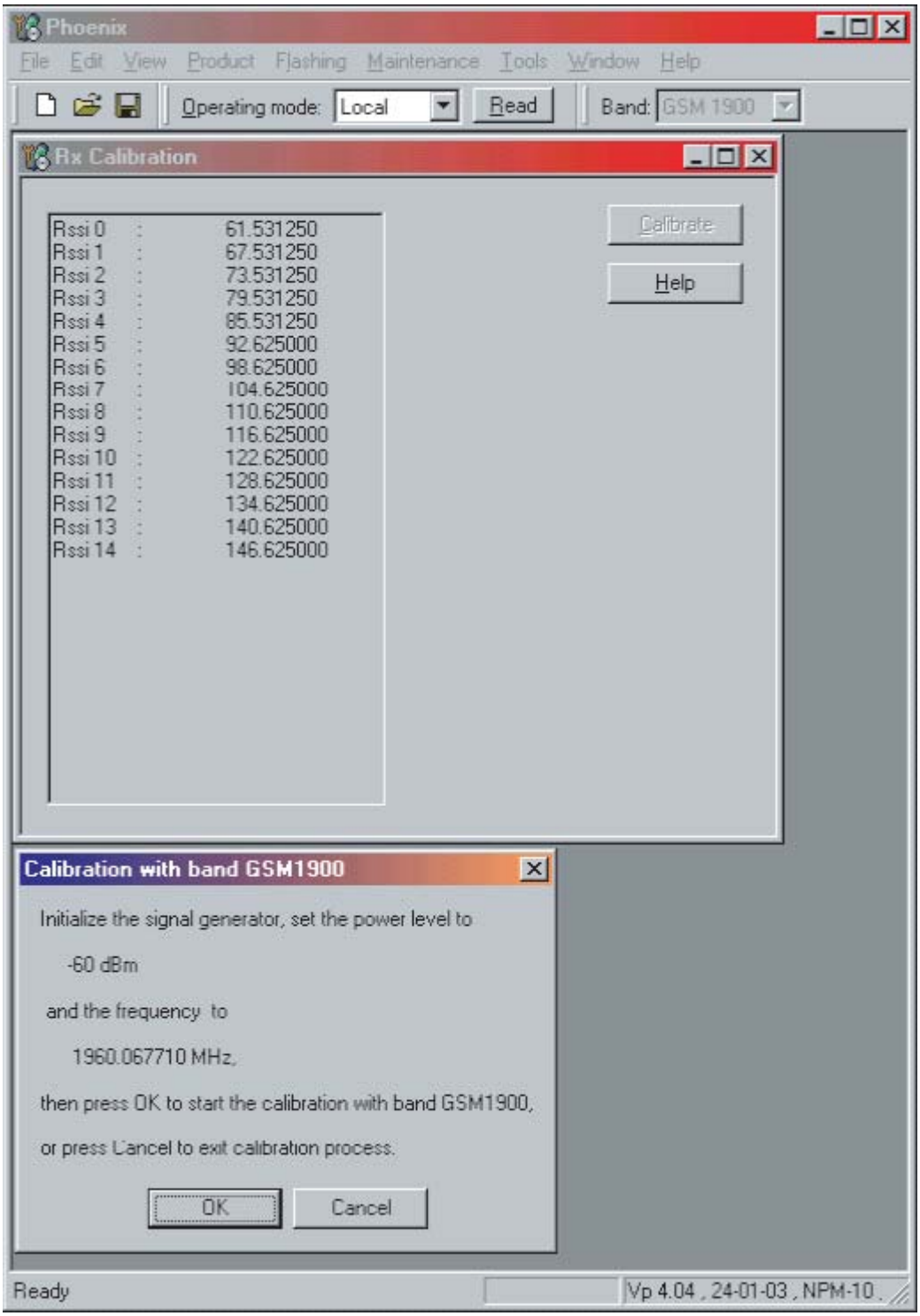

Figure 35: Rx Band GSM 1900 calibration values

8. Click **OK**.
9. New RSSI values are calculated and stored in PM.

Rx Channel Select Filter

Use the following steps to calibrate the Rx channel select filter:

1. Open the **Maintenance** menu, point to **Tuning**, and click **Rx Channel Select Filter Calibration**.
2. Choose whether you want to load values from the phone on the **Phoenix – (Rx Channel Select Filter Calibration)** window.
3. Click the **Auto Tune** button.

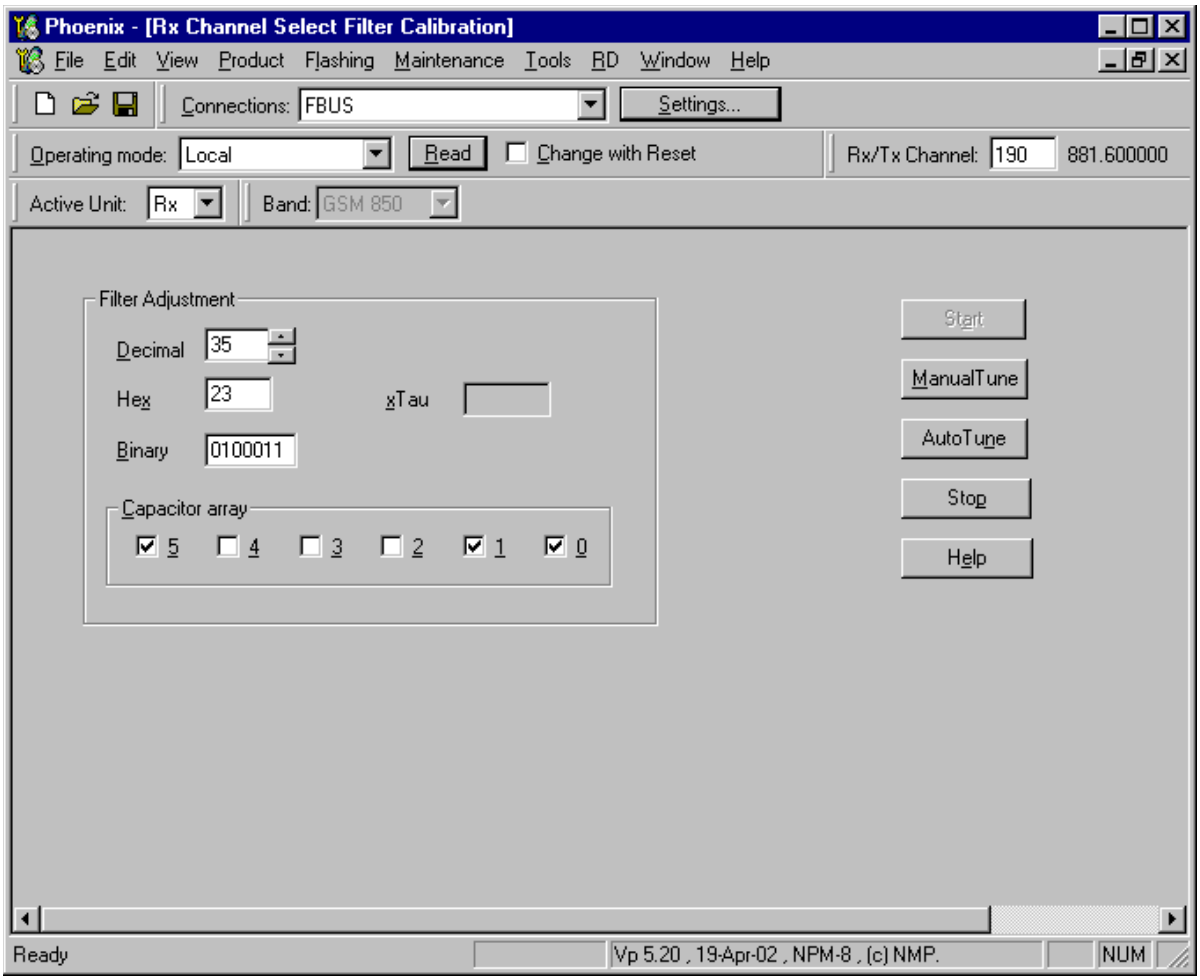

Figure 36: Phoenix – Rx Channel Select Filter Calibration window

4. When finished, press the **Stop** button.
5. Click **Yes** on the **Tune ending** message box if you want to save the values to the phone.

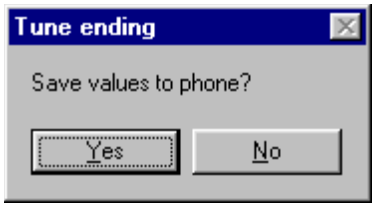

Figure 37: Tune ending message box

Note: This calibration requires no input signal

Rx Band Filter Response

Use the following steps to calibrate the Rx band filter response:

1. Open the **Maintenance** menu, point to **Tuning**, and click **Rx Band Filter Response Compensation**.
2. Click the **Start, Read from PM area** button.
3. Choose whether you want to load values from the phone on the **Rx Band Filter Response Compensation** dialog box.

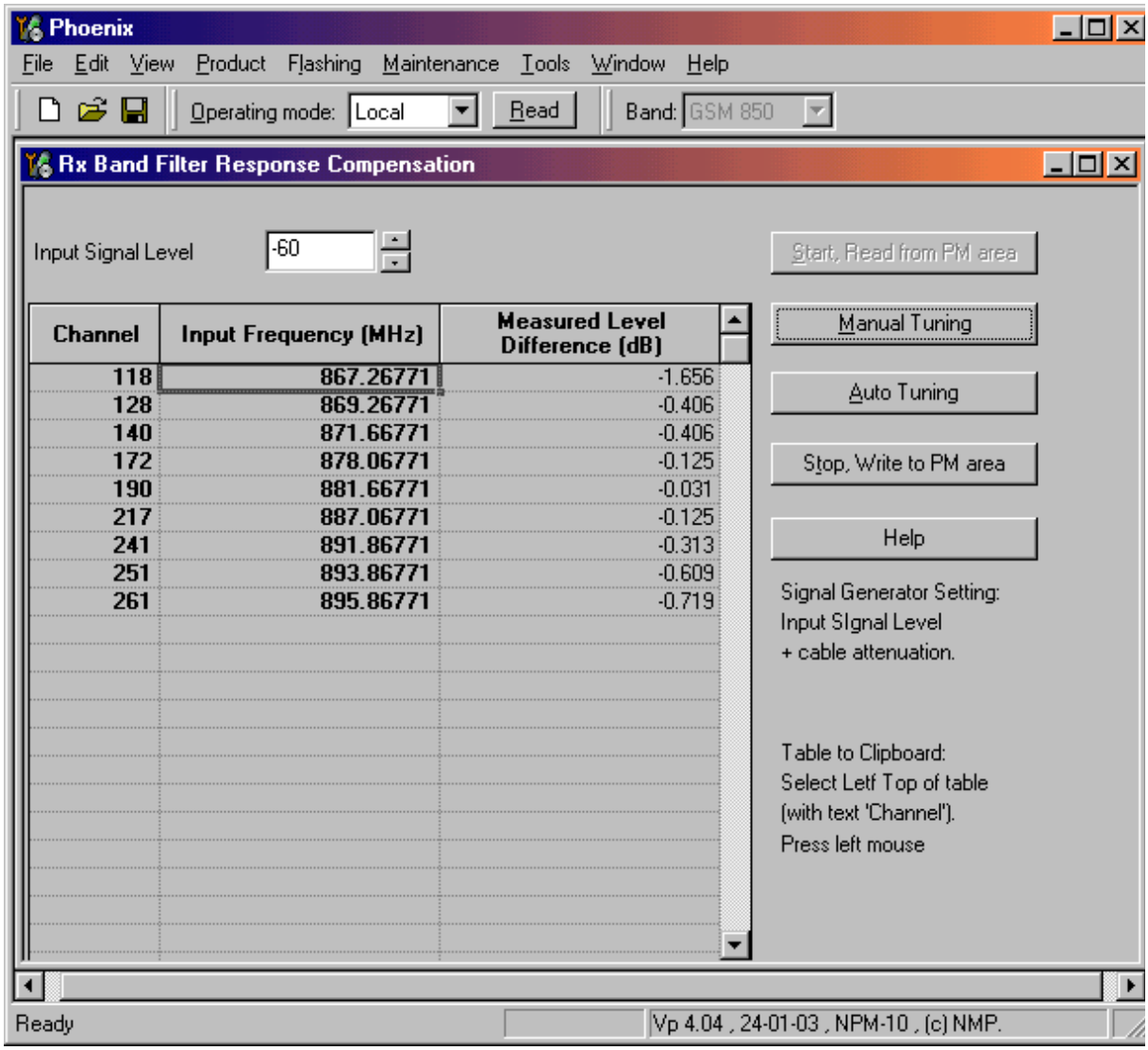

Figure 38: Rx Band Filter Response Compensation dialog box

4. Click the **Manual Tuning** button.
5. Adjust the signal generator settings as specified in the message box.
6. When finished, press the **Stop, Write to PM area** button.

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7. Click **Yes** on the **Tune ending** message box if you want to save the values to the phone.

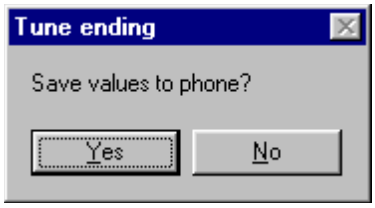

Figure 39: Tune ending message box

8. Repeat steps 1-7 for the GSM 1900.

Note: This calibration requires a lot of different frequencies from the generator. If you have a signal generator with a frequency list option, you can use Auto Tuning (the dwell should be around 10 ms).

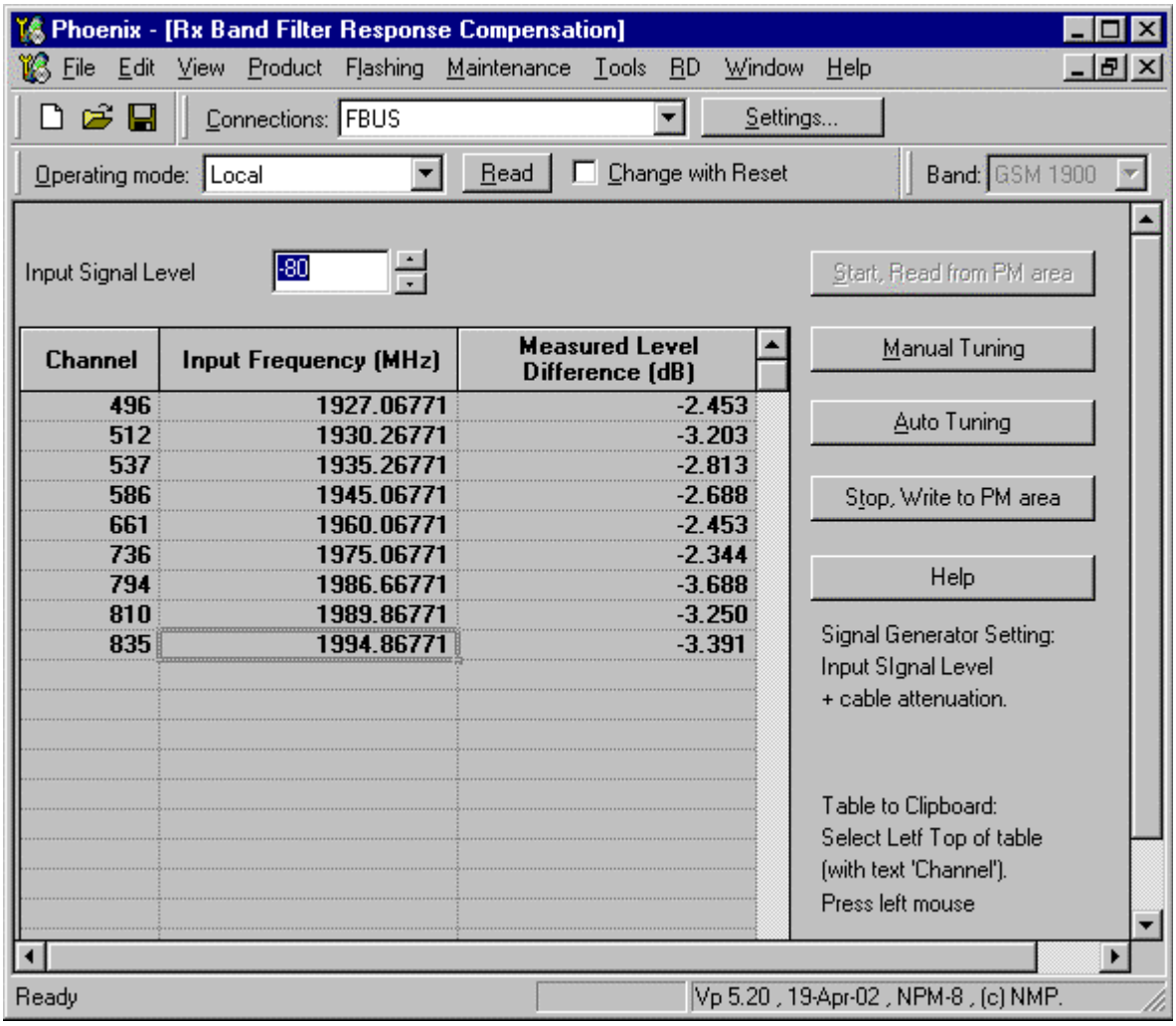

Figure 40: Phoenix - Rx Band Filter Response Compensation window for the GSM 1900.

Tx Tuning

Use the following steps to tune the Tx:

1. Open the **Maintenance** menu, point to **Tuning**, and click **Tx Power Level Tuning**.
2. Press the **Start, Read from PM area** button.
3. Use the following settings and considerations for tuning with a spectrum analyzer:
   - A DC block and at least a 10 dB attenuator on the RF input port to protect the spectrum analyzer
   - A span of 0 Hz (the burst power should be measured)
   - A resolution bandwidth of 1 MHz
   - A video bandwidth of 1 MHz
   - A sweep time of 10 msec
   - A RF attenuation value of 30 dB

Reference level: if you set this to 40 dBm, you can tune both the low band (target output power of 32.0 dBm for power level 5) and highband (target output power of 29.5 dBm for power level 0) at the maximum output levels. The reference level must be reduced, to say 0 dB level when tuning the base level.

Trigger: Video. Set the level to 0 dbm. This must be lowered when you are setting the base level (base level target output power of -30 dBm). If you do not lower the video trigger level to below –30 dBm when tuning the base level, the spectrum analyzer will not be triggered when you are tuning the base level.

Center Frequency: 836.6 MHz (For GSM 850 band, channel 190 is used for Tx output power tuning). For GSM 1900, center frequency is 1880 MHz (mid Channel 661) for Tx output power tuning.

Tx Power Tuning GSM 850

When you enter Tx power level tunings, the **Tx Power Level Tuning** dialog box displays (Figure 41). Phoenix automatically loads the coefficients currently stored in PM. DUT should be transmitting at the channel and frequency shown in the lower left of the dialog box.

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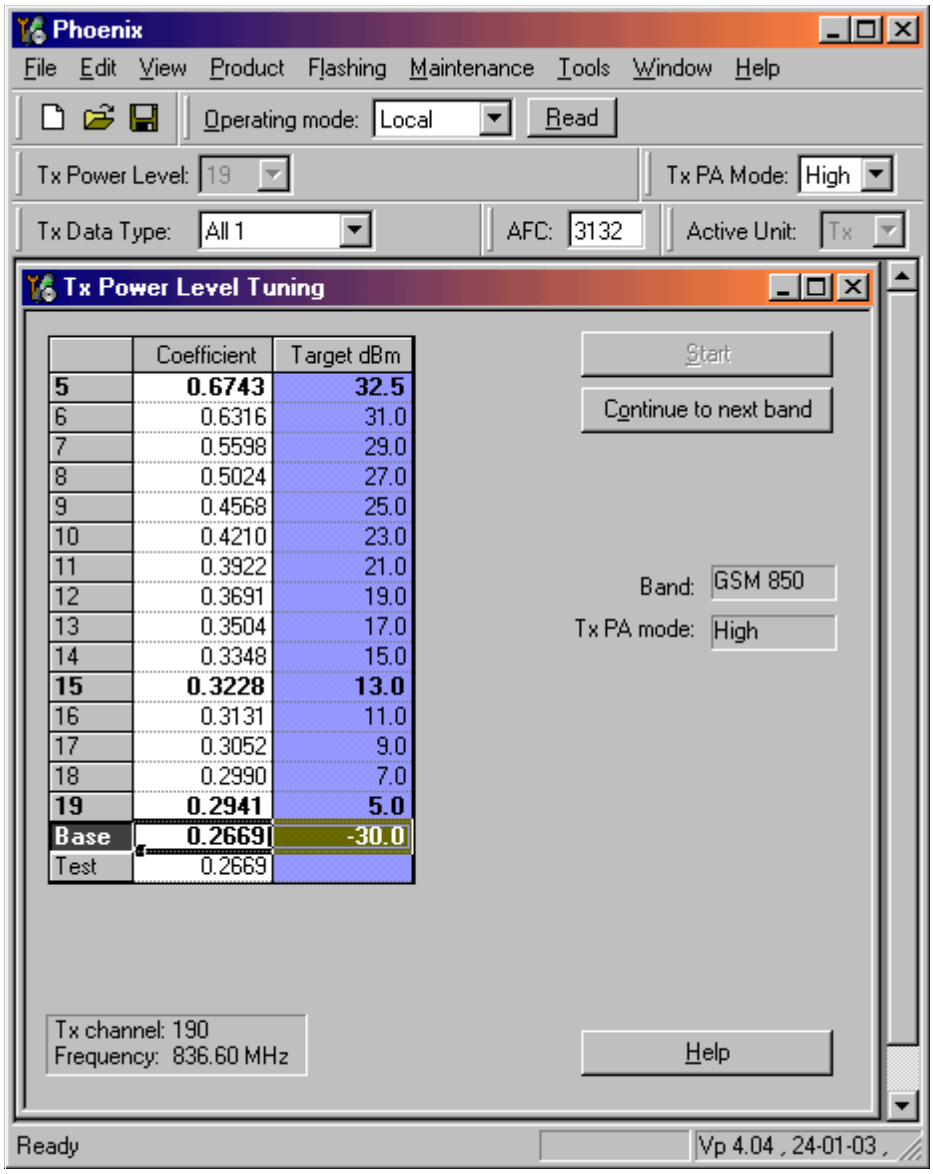

Figure 41: GSM 850 values on the Tx Power Level Tuning dialog box

Use the following steps to tune the GSM 850 Tx:

1. Set the Tx data type modulation to 1, 0, or Random. (Select Random if a GSM tester is used so it can be synchronized to the burst.)
2. Select **High** in the **Tx PA Mode** field. (Do not use Low PA Mode tuning.)
3. The first power tuning should be setting the base level to –30 dBm.
4. Tune the values that appear **bold** in Figure 41 to the target values in the Target dBm column (highlighted in blue). Use the average burst power. Also, note that the PL5 target value is 32 dBm, *not* 32.5 dBm.
5. Click the **Continue to next band** button.
6. Phoenix calculates the coefficients for the remaining power levels, saves them to permanent memory, and proceeds to the 1900 MHz power level tuning.

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Tx Power Tuning PCS 1900

Repeat steps 1-6 from the "Tx Power Tuning GSM 850" section above for the 1900 MHz. After you tune the power levels, which appear **bold** in Figure 42, click **OK**. Phoenix calculates the coefficients for the remaining power levels and saves them to permanent memory.

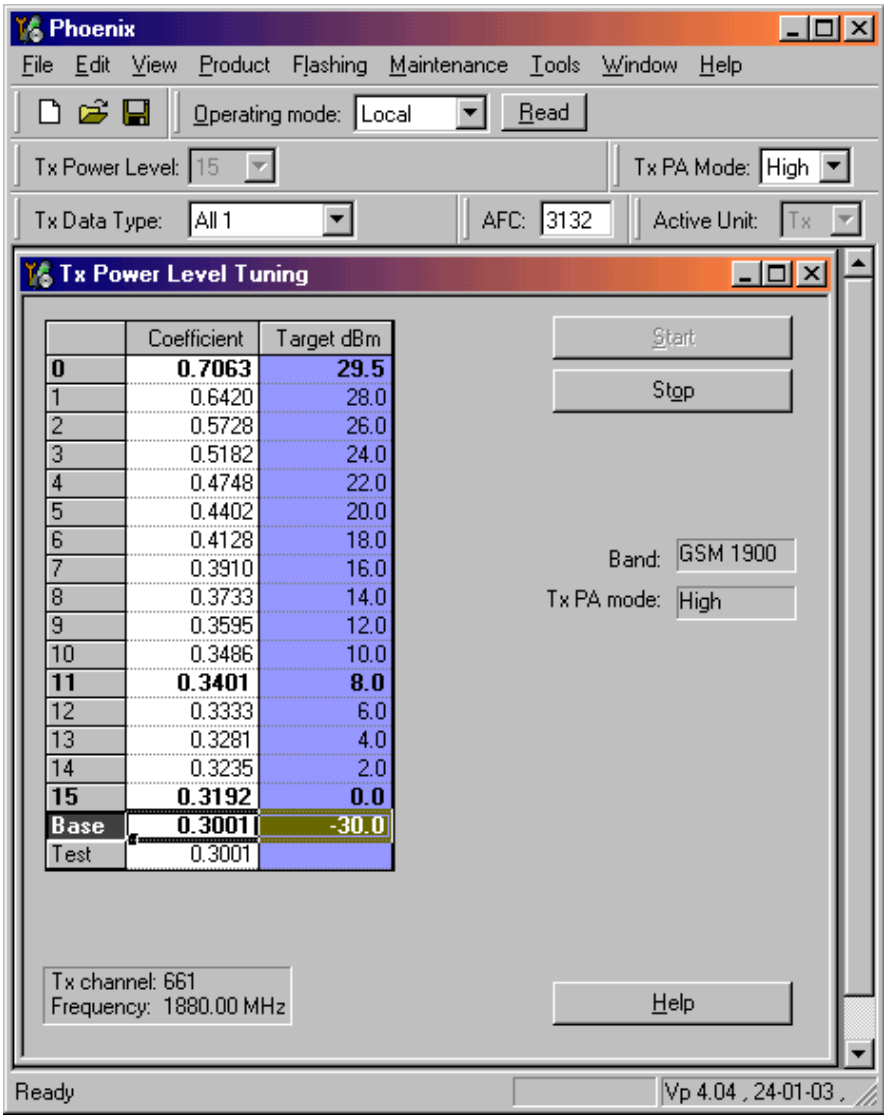

Figure 42: GSM 1900 values on the Tx Power Level Tuning dialog box

Tx I/Q Tuning

Use the following steps to tune the Tx I/Q:

1. Open the **Maintenance** menu, point to **Tuning**, and click **Tx IQ Tuning**.
2. Use the following spectrum analyzer settings for Tx I/Q tuning:
   - Same center frequencies for GSM 850 (Ch190 = 836.6 MHz) and GSM 1900 (Ch661 = 1880 MHz) as in the Tx output power tuning
   - Span = 200 kHz
   - RBW = 10 kHz

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- VBW = 1 kHz
- Sweeptime = .5 seconds
- RF attenuation = 20 dB
- Reference level = 30 dBm
- Trigger = free run

3. Select where to get the values. Typically, you would click **Load From Product**.
4. Push the Start soft key.
5. Use the sliding arrows or the + and - keys to adjust the **Tx I DC offset** and **Tx Q DC offset** values to reduce the carrier frequency to a minimum. The carrier must be at least –30 dBc. Typically, carrier suppression is better than –40 dBc.

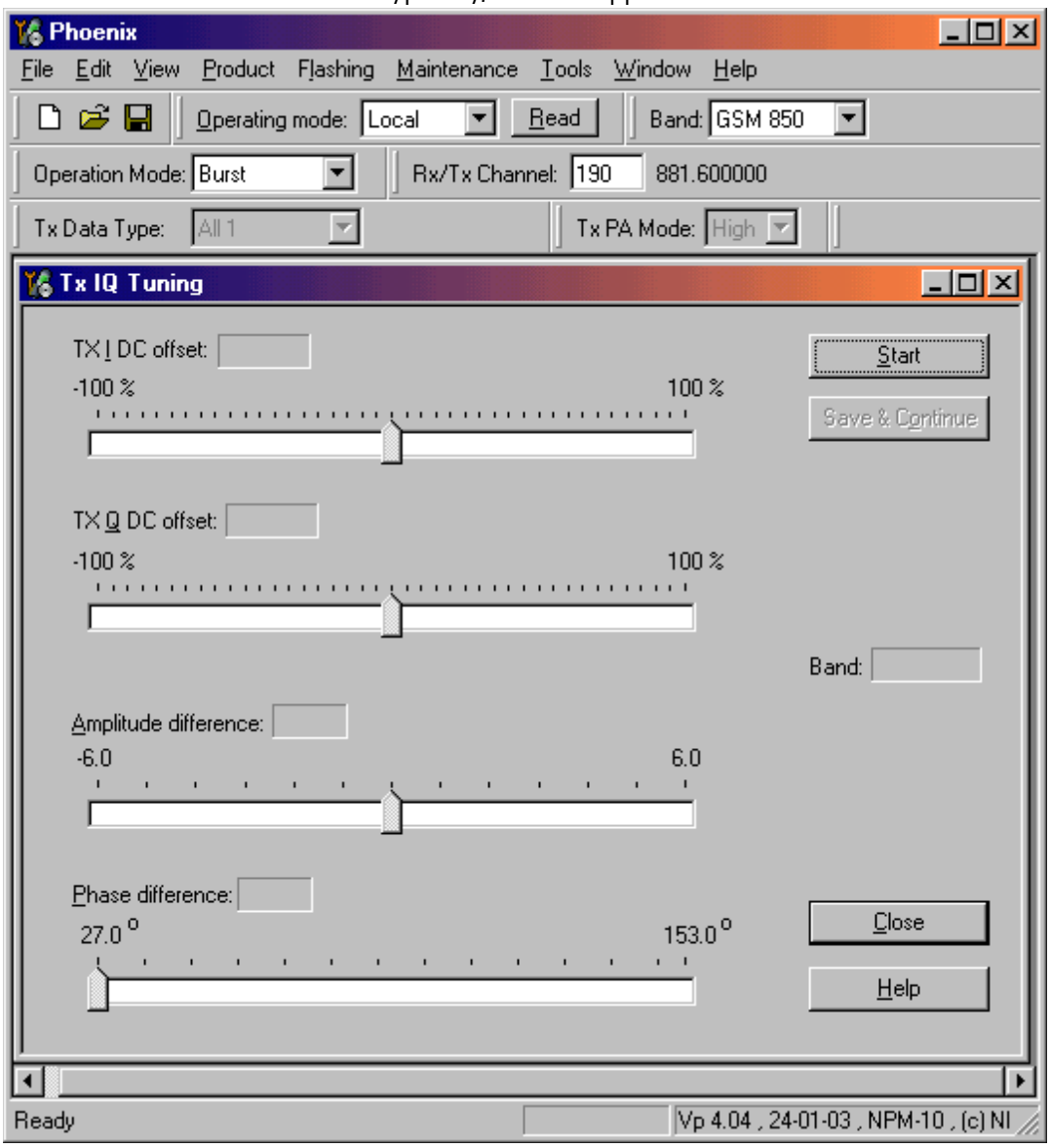

Figure 43: Tx IQ Tuning dialog box settings

6. Use the sliding arrows or the + and - keys to adjust the **Amplitude difference** and **Phase difference** values to reduce the lowest sideband frequency. The sideband must be reduced at least –35 dBc. Typically, sideband suppression is better than -40 dBc.
7. Ensure that the IQ tuning values meet the specifications for both 1 and 0 data types.

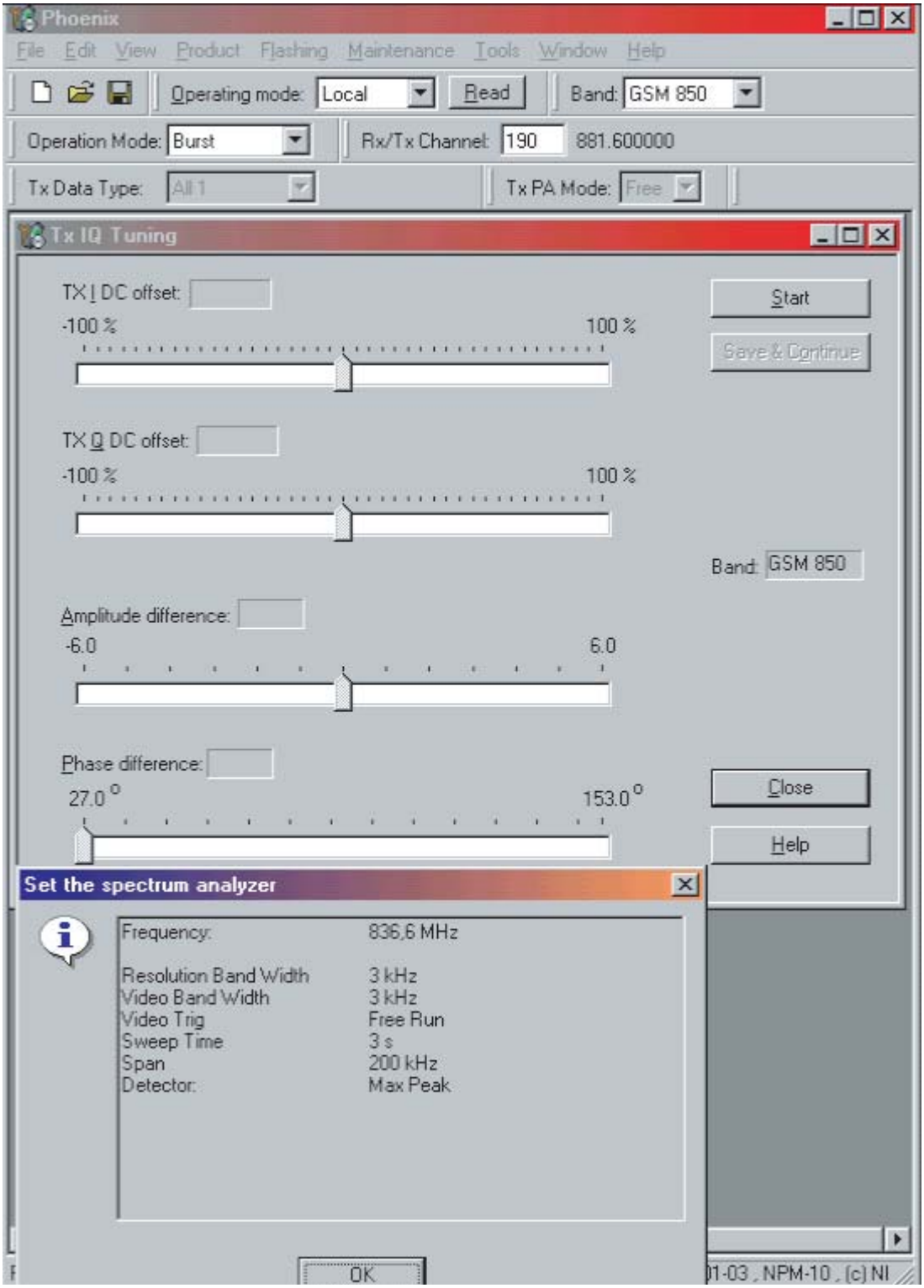

Figure 44: GSM 850 Tx IQ tuning values on the Set the spectrum analyzer message box

8. Select the **Save to Product** box if you want to save the tuning values to the phone.
9. Push the Stop soft key. This ends tuning and saves the values to the phone if you have selected the **Save to product** box.
10. Repeat steps 1-11 for the PCS 1900 using channel 661. Figure 45 includes typical tuning values for the PCS 1900.

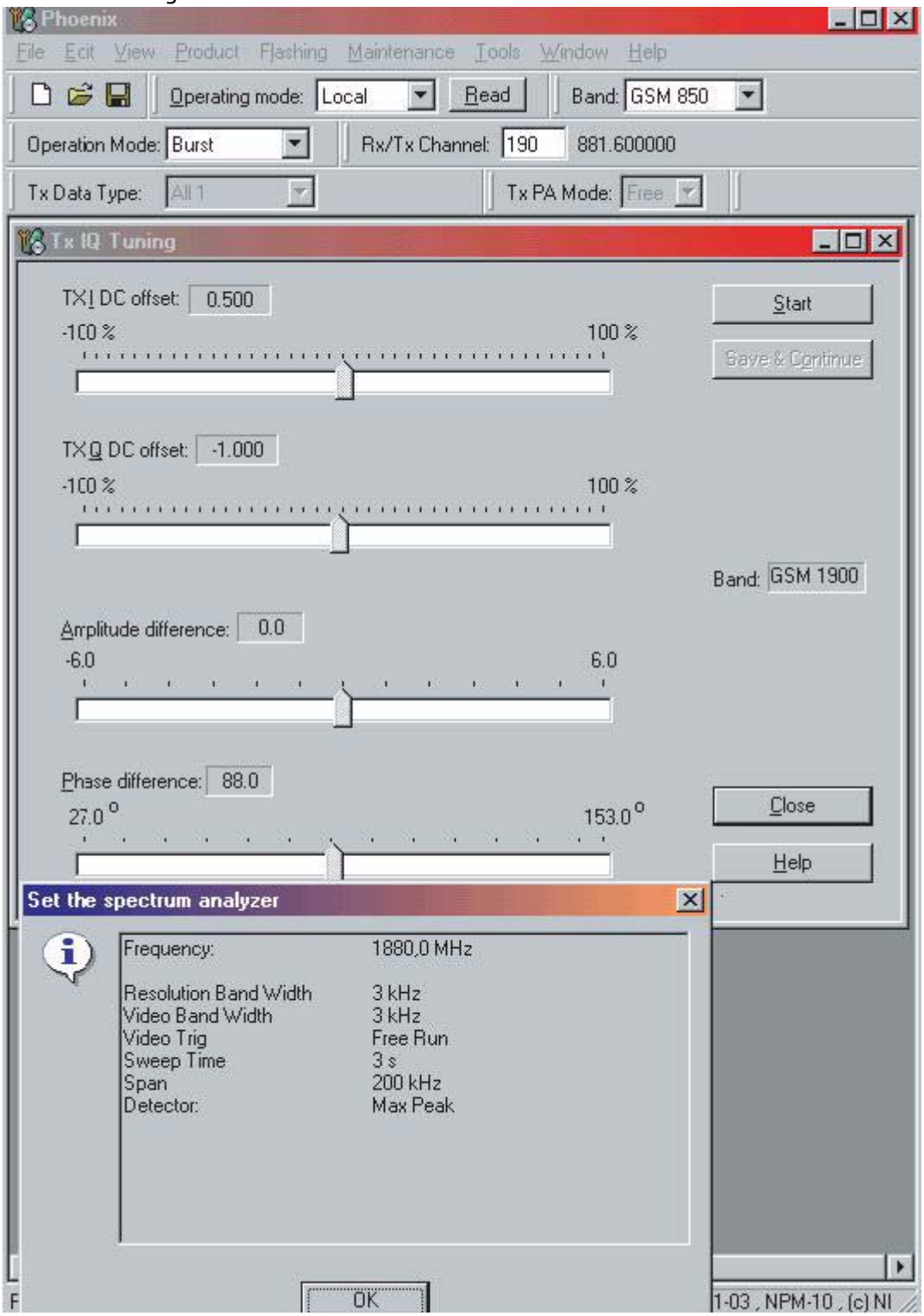

Figure 45: PCS 1900 Tx IQ tuning values on the Set the spectrum analyzer message box

RF Control

Use the following steps to check the receiver or transmitter without going in a call. This process is similar to a call, but you have control through the PC instead of the tester. Ensure that the GSM 850 Tx PA mode is set to High.

1. Open the **Maintenance** menu, point to **Testing**, and click **RF Controls**.
2. If you want to tune at other channels than the default, then you must select the channels first in RF control and then start the tuning.

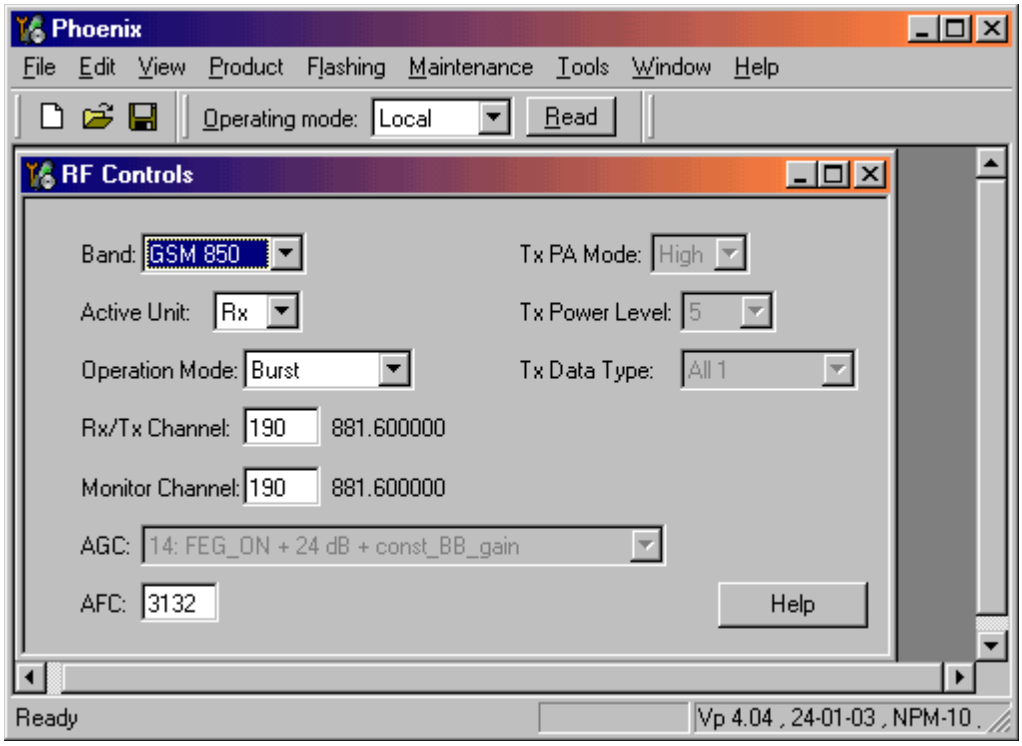

Figure 46: RF Controls dialog box

Call Testing

A call is the ultimate test of the phone if the tunings are complete and the phone's Tx and Rx are working properly. Use the following steps to manually test the phone with a call:

1. Set the communications tester to manual test.
2. Switch the phone to Normal if it was in Local Mode. Remember to have a test simcard in the phone.
3. A call can be made after the phone has registered to the communications tester. It is possible to let the phone answer via Phoenix.
4. In the Autocaller (Maintenance Testing) you can answer by ticking Answer when button pushed and then push the button.

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